



Sea2City Design Challenge —

South False Creek Coastal Adaptation Design Report

Design & Planning Brief

Adaptive Design Brief

First Step Costing Brief

December 2022



Sea2City DESIGN CHALLENGE

Land Acknowledgement—

Flanked to the north by Burrard Inlet, to the west by the Salish Sea, and to the south by the north arm of the Fraser River, Vancouver has always been a coastal community defined by its proximity to the ocean, river and mountains. Vancouver is situated on the unceded traditional homelands of xʷməθkʷəy̓əm (Musqueam), Skwxwú7mesh (Squamish), and səliłwətał (Tsleil-Waututh). The area currently known as False Creek is of significant meaning to the local First Nations who stewarded the land since time immemorial.

The authors would like to thank the City Advisory Team, the Technical Advisory Group, the Community Advisory Group and the Youth Adaptation Lab for providing support, insights and advice during the course of this work.

City Advisory Team:

Amir Taleghani, P.Eng., Engineering
Andrew Phillips, Indigenous Relations Planner
Angela Danyluk, RPBio, Project Manager
Brad Badelt, P.Eng., Sustainability Group
Brian Sears, Real Estate and Facilities Management
Claire Lee, CMHC-Granville Island
Cory Dobson, Planning, Urban Development & Sustainability
Debra Barnes, Park Board
Dora Li, Planning, Urban Development & Sustainability
Ginger Gosnell-Myers, Squamish Nation
Hayley Hoikka, Planning, Urban Development & Sustainability
Holly Schmidt, Engineering Artist-in-Residence
Jeannie Lee, P.Eng., Engineering
Jeremie Stephenson, Finance
Jordan McAuley, Park Board
Justin Li, P.Eng., Engineering
Kathleen Edwards, Squamish Nation
Kelly Carswell, Environmental Services
Marga Pacis, Assistant Project Manager
Natalia Myles, P.Eng., Engineering
Natasha McPherson, Engineering
Oswal Fuentes, Real Estate and Facilities Management
Rachel Telling, Assistant Project Manager
Sanya Pleshakov, Tsleil-Waututh Nation
Sarah Sutton, Real Estate and Facilities Management
Sarah Dal Santo, Tseil-Waututh Nation
Sebastian Lippa, CMHC-Granville Island
Tugce Conger, Ph.D, Engineering

Technical Advisory Group:

Andreanne Doyon, Simon Fraser University
Brent Burton, P. Eng., Metro Vancouver
Danilo Caron, University of British Columbia
DG Blair, M.Sc., Stewardship Center for BC
Grant Lamont, P.Eng., Northwest Hydraulic Consultants
Isabel Kunigk, space2place
Jantsje van Loon, Wageningen University and Research
Jeff Cutler, space2place
Jessica Wilson, P.Eng., Northwest Hydraulic Consultants
Jim Papadoulis, P.Eng., BC Hydro
Kees Lokman, University of British Columbia
Khidhir Jorj, M.Sc, P.Eng., EXP Services
Mark Potyrala, RPBio, Department of Fisheries and Oceans
Mathilde Jung, Living with Water - UBC
Mujib Rahman, P.Eng., Fortis BC
Patrick Lilley, RPBio, Kerr Wood Leidel
Rebecca Seifert, Department of Fisheries and Oceans
Sara Jossul, RPBio, Department of Fisheries and Oceans
Tamsin Lyle, P.Eng, Ebbwater Consulting
Tira Okamoto, Living with Water - UBC
Tsjerck Vandoornik, Living with Water - UBC

Community Advisory Group:

Andrea McDonald
April Treackle
Clare Wilkening
Evan Gale
Helen Lui
Imogene Broberg-Hull
Katherine Lauriente
Liz Dong
Maura Brown
Nati Herron
Patricia Schavarosk
Raphael Dipasupil
Sharman King
Steve Ellis
Warren Walker
Yael Stav
Zaida Schneider

Youth Adaptation Lab:

Trisha Barbarona
Nabila Basri
Natasha Birdi
Pierce Burns
Shalen Chen
Emma Griggs
Gary Ip
Lisa Iqbal
Alex McHugh
David Minic
Sayemin Azam Naheen
Jasmin Ogilvie
Adjoa Quainoo
Lia Laureen Schulz
Corrina Tang



Team Members:

Mithun:
Debra Guenther
Shannon Lee
Chuck McDowell
Zoe Kasperzyk
Laura Durgerian

One Architecture:
Matthijs Bouw
Justine Shapiro-Kline
Rennie Jones
Pranav Thole

Modern Formline:
Cory Douglas

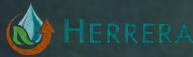
Herrera:
Andrea MacLennan
Brian Busiek

Moffatt & Nichol:
Younes Nouri
Rob Sloop
Liyenita Widjaja
Michael Cho

Cultural Advisor:
Charlene Aleck



MITHUN
one architecture



Special thanks to Charlene Aleck, Cultural Advisor

MITHUN

Seattle
Pier 56, 1201 Alaskan Way #200
Seattle, WA 98101

San Francisco
660 Market Street #300
San Francisco, CA 94104

Los Angeles
5837 Adams Blvd
Culver City, CA 90232

mithun.com—

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Design and Planning Brief—



Introduction

"Taking my place in the footsteps of my ancestors that once used to hunt in these areas and gather and do their business, I welcome this group that is pulled together to make a better place to be in reciprocal relationship with the land and the water and reciprocal relationship with the First Nations People on this territory - Musqueam, Squamish, Tseil-Waututh, and the people of Vancouver."

— Charlene Aleck

The Design and Planning Brief is intended as a supporting document for the design response for the Sea2City Design Challenge. This document supplements the design team's presentations for Collaboratorium 2, Collaboratorium 3, as well as the final design boards for the Olympic Village and Stamps Landing sites and the first step pilot projects. The purpose of this brief is to highlight the key design and planning considerations that were encountered through the research phase, site inventory and analysis, design and in processing feedback and stories through the various mechanisms for feedback for stakeholder groups.

The City and design teams engaged in both targeted and open ended conversations around the topics of False Creek, coastal adaptation, decolonization, indigenous perspectives, community values, etc. The venues for hearing from stakeholders, community, and technical resources included:

- Collaboratoriums 1, 2, and 3
- East of Cambie Design Charrette
- Decolonization and Indigenous Perspectives Workshops
- Conversations with Musqueam, Squamish and Tsleil-Waututh representatives and practitioners
- One-on-one conversations with City representatives
- Community and Technical Advisory Group Conversations
- Youth Adaptation Labs
- Community Outreach Events
- Previous feedback and community values compiled by the City

Central to this work was listening to stories, oral histories, knowledge and values directly from Musqueam, Squamish and Tsleil-Waututh peoples. These conversations include:

- Decolonization & Indigenous Perspectives Workshop 1
- Art and Reconciliation Workshop, Cory Douglas
- Project Delivery with Indigenous Communities Conversation, Danilo Caron
- Conversation with Chief Ian Campbell
- Squamish Nation Archaeological Process, Aaron Marchant
- Decolonizing the Shoreline Presentation
- False Creek Boat Tour, Charlene Aleck & Cory Douglas
- Decolonization & Indigenous Perspectives Workshop
- Conversation with Senaqwila Wyss
- Ongoing conversations with Cultural Advisors Cory Douglas & Charlene Aleck

In highlighting some of the design and planning strategies detailed in the presentations and final design boards, this brief will focus on the following Key Design and Planning Considerations that have been addressed in defining a path forward toward implementation.

- Decolonized Approach to Coastal Adaptation
- Responding to Risk
- Coordination with City Planning Efforts
- Building Ownership and Lease Periods
- Affordability and Place Attachment
- Hydrology, Water Quality and Infrastructure
- Restoring Target Ecosystems



Decolonized Approach

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Process

The Mithun+One Team's approach to this work centered on listening, learning, and letting conversations and stories guide the design and planning approach.

Through conversations with the team's cultural advisors and hearing from Musqueam, Squamish and Tsleil-Waututh representatives in the Decolonization and Indigenous Perspectives workshops, a few themes and priorities emerged that guided the team's approach in defining a decolonized design process.

Design is About Listening

The Sea2City Design Challenge has asked participants to think about the uncertainties, opportunities, and challenges of adaptation in a different way. Considering the issues and the approach to addressing the issues with an open mind and an open heart changes the way that planning is done. Instead of listening to validate ideas, whether they are from past experiences or the application of ideas from other parts of the world, listening has to be done to hear, and to let the conversations, stories, and learnings guide the outcomes. The preconceived notion that coastal adaptation can be solved by the siloed views that created the problems has been challenged. Instead of cultural and traditional knowledge and values being used to inform predetermined design outcomes, those design outcomes are instead being shaped and centered around traditional knowledge and values.

When conversations and stories are the driver in the design process, the design response must stay flexible and open enough to allow the space for trust to be developed so that the conversations and stories can lead in the design process.

Understanding the Context of Reciprocity

When entering into a conversation or into a planning process, it must be done with the intention of reciprocity. Often times, this approach may be seen in the context of achieving balance or finding compromise when presented with the challenge of addressing multiple issues with limited resources and especially when the urgency of time is involved. Putting balance and compromise into the context of time, time immemorial, and impacts of colonization on Musqueam, Squamish and Tsleil-Waututh peoples requires the consideration of the question: "What has already been given and what has already been taken?" In planning for future generations, consideration must be given to the impacts and harms of past generations and instead of prioritizing compromise and balance to address short-term priorities and actions, the long-term implications of planning decisions must first and foremost address reciprocity as a primary goal. The following questions should be asked: *What would shared stewardship and co-management look like and what would Land Back look like? What interim steps are needed to get there?*

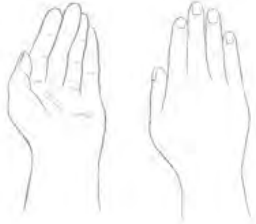
The Importance of the Spoken Word and Storytelling

This written brief and other reports that come from this work have an important role in the planning process, however it is a very different way of communicating than what is gained through the act of storytelling, listening, and engaging in conversation. Oral storytelling is done viscerally and with senses and emotion in mind. The deep connections and emotions that storytelling taps into are not easily replicated in written reports and that must be acknowledged. The raw emotion evoked when talking about colonization,

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REPAIR



the cultural and environmental harms which colonization has brought on, and the equally strong feelings of hope that come when talking about how the shoreline can be adapted in a way that centers Musqueam, Squamish and Tsleil-Waututh cultures while healing the land and waters is nearly impossible to communicate in this brief.

The presentations and visualizations shared through this process are things to reflect back upon but what will keep momentum moving in a new direction are the relationships and memories of the conversations had during this process in the Collaboratoriums and the Decolonization and Indigenous Perspectives Workshops. Through these venues, community members, city staff, technical consultants, Musqueam, Squamish and Tsleil-Waututh members, and the design teams have shared experiences that will influence these individuals in different ways. Bringing the emotions including those of pain and harm as well as hope is critical to share a different path forward and connect the dots between a process that emphasizes decolonization and one that works towards realized outcomes of a decolonized False Creek.

Working Toward Decolonized Outcomes

This decolonized process must lead to decolonized outcomes and a decolonized shoreline in order to realize the City's obligations to reciprocity.

A really important early question that was asked amongst the Mithun+One Team early on in this process was: What does a decolonized False Creek look like?

The root of this question is about whether development and colonized uses of the shoreline should exist in the future as they have in the past. Knowing that the majority of the area north of 2nd and 6th Avenue, including both Olympic Village and Stamps Landing, were tidal marshes and open water that was filled in the early 1900s and 1970s, the question of whether a decolonized shoreline includes any fill or development was explored. Should a decolonized False Creek Shoreline build back better, more responsive to future tidal fluctuation and maintain development and an urban presence in those filled in portions of False Creek, or should a decolonized False Creek work toward a vision that backs development away from those filled areas, that removes buildings and people from sea level rise flooding areas and the unknown impacts of groundwater rising into contaminated areas, allowing the space to heal the land and water and for Musqueam, Squamish and Tsleil-Waututh Peoples and Vancouver residents to reconnect with a False Creek that better reflects the past ecologies of this space?

The team's approach to coastal adaptation along the south side of False Creek focused on the latter, where the shoreline is returned to the land and water, human actions are focused on restoration and creating space for cultural reconnections and healing to occur.

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Vision for South False Creek

The vision for a decolonized False Creek is one that reframes the City's relationship with the shoreline, the processes that shape it, and how it is inhabited.

A holistic view of False Creek reconnects the watershed to the hydrologic and ecological functions of the shoreline, tidal, and marine environments. As a shared stewardship of this land is curated, the people of Vancouver will continue to learn to live with and reestablish a relationship with the fluctuations of the tides.

An adaptation pathway that takes a decolonized approach shifts investments from those that protect and hold the line to those that allow the repair and restoration of the lands and waters that have been impacted by the pressures of our society over recent generations. Areas of False Creek that were filled in, industrialized, and redeveloped will be restored, while redevelopment shifts in an incremental and intentional way away from these areas.

This space is envisioned as a place where the Musqueam, Squamish and Tsleil-Waututh Nations can practice, celebrate, share their cultures, and co-manage the landscape as a part of an ongoing conversation with the City of Vancouver. In this landscape that they have stewarded since time immemorial, False Creek is once again a place where they can see themselves and their values and knowledge represented. The future of False Creek is a place for all people and all creatures and diverse plant species to cohabitate. It represents a place of shared values, natural abundance, and optimism about our role in helping heal the land and water for future generations.



2100+ Vision for South False Creek



2100+ Vision for Olympic Village





2100+ Vision for Stamps Landing





2100+ Vision for Host Corridor & 1st Ave Blue-Green Corridor





Design and Planning Principles

Early design and visioning on how design and planning can be the catalyst for realizing the vision of a restored and repaired False Creek relies on defining design and planning strategies and principles that move away from the business as usual approach and instead reframe the city and community's relationship with the land and water edge. These principles focus on the overlap of physical infrastructure, community values, relationships with the shoreline and overlay multi-generational and cultural layers to identify a suite of multi-benefit strategies for the False Creek shoreline.

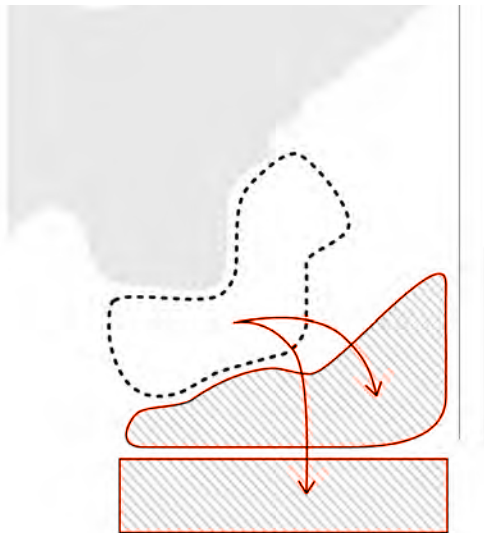
"We need to learn from Indigenous Peoples, Knowledge Keepers, and elders and reimagine our shoreline where not only the land and waters are restored but also our relationships to each other and our relationships to the land."

— Angela Danyluk

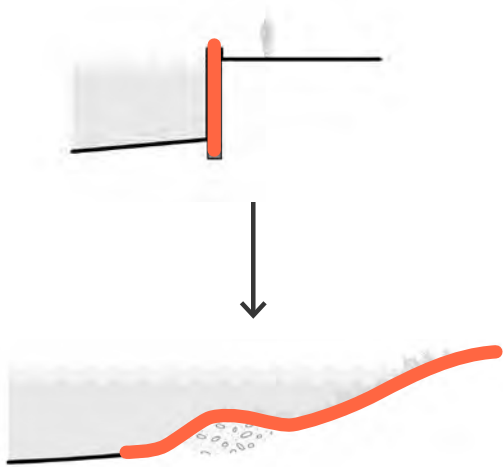
Learn From and With Musqueam, Squamish and Tsleil-Waututh Over Time



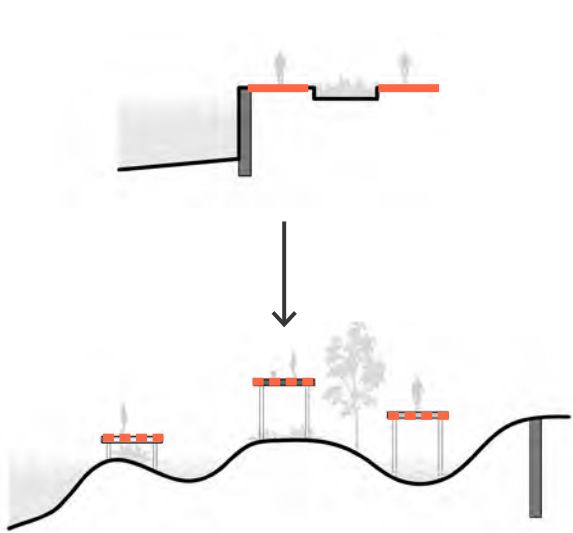
Maintain Housing



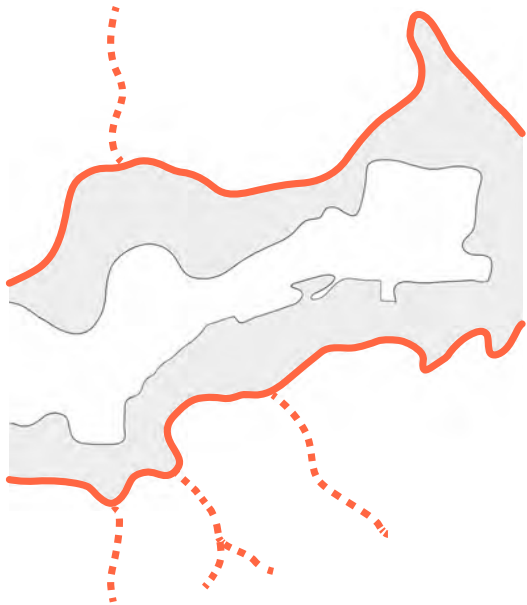
Increase Diversity of Shoreline



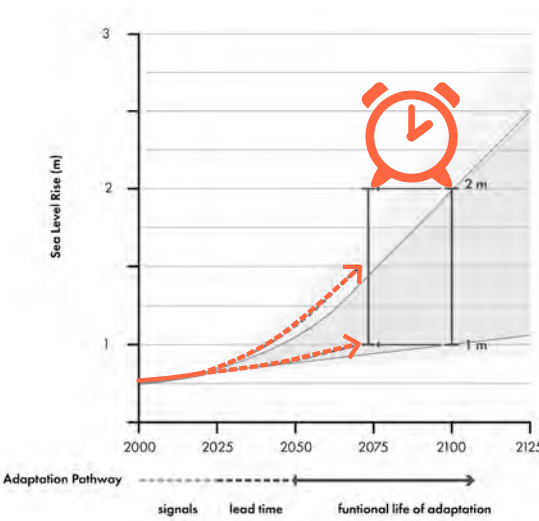
Increase Diversity of Experiences



Respect Natural Forces



Practice Adapting



Key Design & Planning Considerations



Responding to Flood Risk

The Sea2City Design Challenge has tasked the design teams to consider the impacts of 1 meter of sea level rise by the year 2100 and an additional 1 meter of sea level rise by 2200. The City of Vancouver's Coastal Adaptation Map Atlas for False Creek highlights the potential impacts of sea level rise, identifying the areas at risk within the floodplain across all of False Creek. The table below summarizes the current and anticipated tidal levels within False Creek as the sea level rises over the coming centuries. The three tables to the right highlight the existing elevations at the top of the seawall along the south side of False Creek in areas including the Stamps Landing, East of Cambie, and Olympic Village sites. The analysis of the shoreline elevations indicate that coastal storm events nearing the 500 year/ 0.2% AEP events are likely the only events that cause overtopping at present day. However, coastal events, coupled with upland flood events contribute to compounding impacts, flooding some of these areas today.

TIDAL LEVELS IN FALSE CREEK			
WATER LEVEL	TODAY	2100*	2200**
1:500YR; 0.2% AEP EVENT	2.94	3.94	4.94
HIGHER HIGH WATER LARGE TIDE (HHWLT)	1.91	2.91	3.91
HIGHER HIGH WATER MEAN TIDE (HHWMT)	1.39	2.39	3.39
MEAN WATER LEVEL (MWL)	0.02	1.02	2.02
LOWER LOW WATER MEAN TIDE (LLWMT)	-1.87	-0.87	0.13
LOWER LOW WATER LARGE TIDE (LLWLT)	-3.01	-2.01	-1.01

Geodetic Datum. Table adapted from tides.gc.ca Kitsilano -07707 Station and Coastal Adaptation Map Atlas.
*SLR anticipated to be +1m at 2100
**SLR anticipated to be +2m at 2200.

STAMPS LANDING TOP OF SEAWALL	
LOCATION	ELEVATION
1	2.75
2	2.79
3	2.77
4	3.72
5	2.64

*Geodetic Datum

EAST OF CAMBIE TOP OF SEAWALL	
LOCATION	ELEVATION
6	3.62
7	3.57
8	3.20
9	2.75
10	3.35

*Geodetic Datum

OLYMPIC VILLAGE TOP OF SEAWALL	
LOCATION	ELEVATION
11	3.34
12	3.92
13	3.98
14	3.74
15	3.42

*Geodetic Datum

South False Creek Flood Prone Areas

The City of Vancouver Coastal Flood Risk Assessment defines a target Flood Construction Level (FCL) of 4.6m(GD). The map below identifies flood prone areas based on existing elevation, that are below 3.94m. This elevation represents 1 meter of sea level rise, projected for 2100, plus a 500 year; 0.2% AEP event. Areas higher than 4.6m are significantly less vulnerable to sea level rise within the 2100 planning horizon.



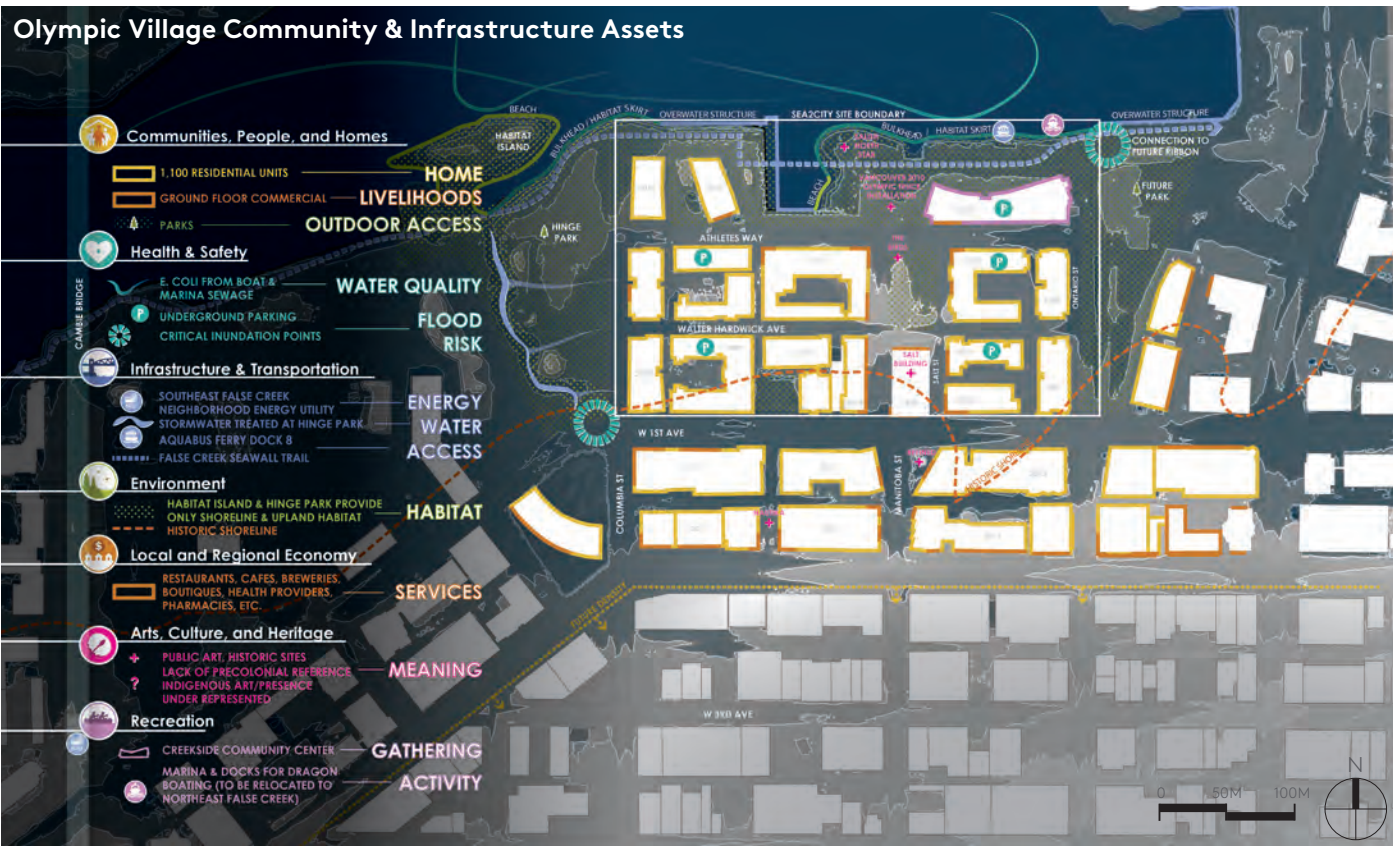
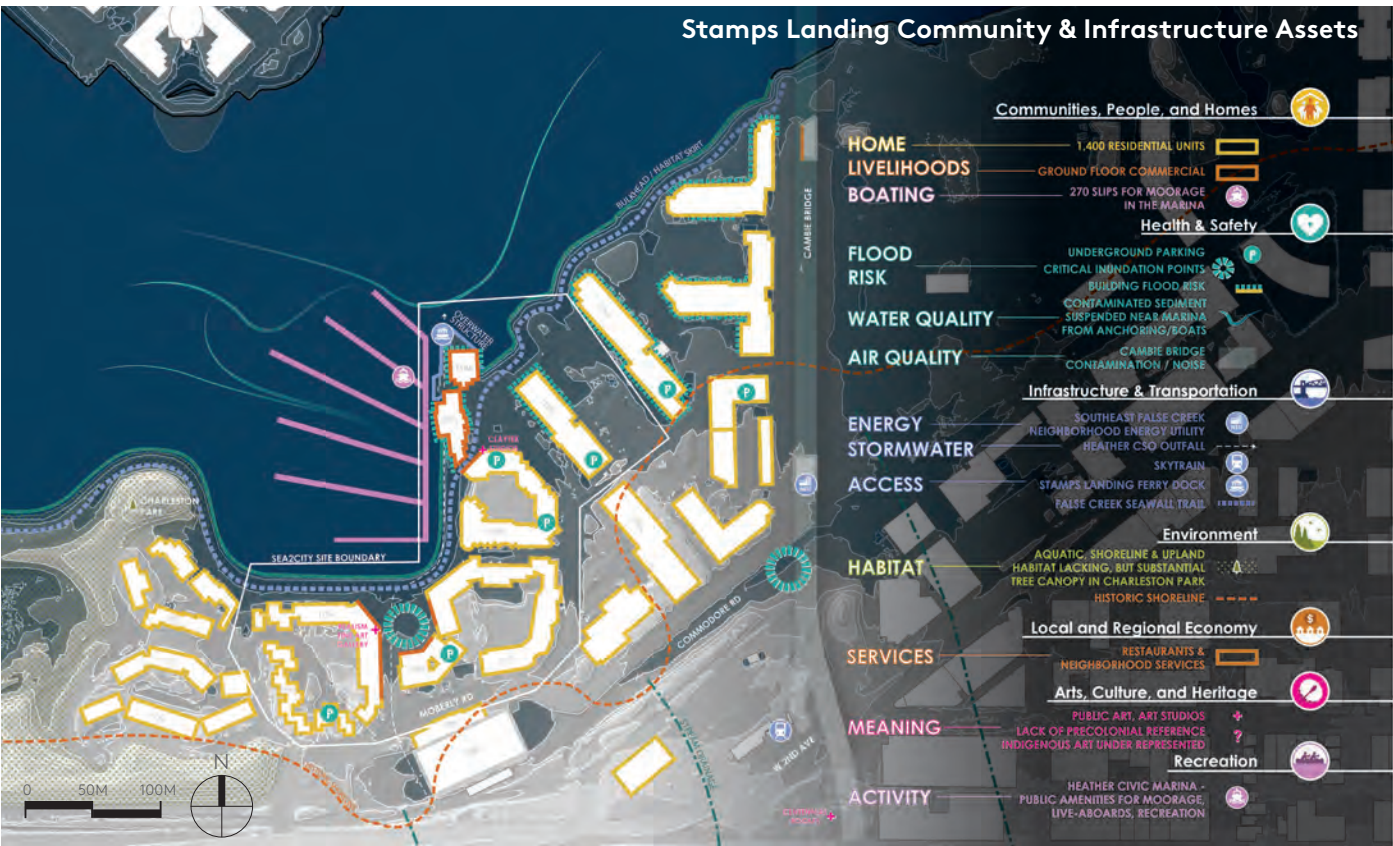


Findings & Key Issues

- Although coastal events over topping of the existing seawall along this portion of False Creek are infrequent today, sea level rise will affect different areas along the shoreline of False Creek disproportionately.
- This stretch of shoreline is not exposed to and is sheltered from energetic waves. As a result, coastal flooding will occur as a result of "high tide flooding". SLR will exacerbate coastal flooding. Given SLR will occur gradually, there will be time for adaptation. Planning level studies should establish check points/thresholds for when SLR mitigation measures should be implemented.
- 1 meter of sea level rise will result in the overtopping of the seawall during higher high water large tide events. These events will see water reaching +/- 2.91m which will overtop areas at Stamps Landing.
- Although overtopping will not occur during daily high tide events at Stamps Landing, nuisance flooding will become common as only about 0.3 meters will separate high tide from the top of seawall elevation.
- Olympic Village is less vulnerable than Stamps Landing. With the top of sea wall elevation ranging from 3.3 - 4.0m, large events nearing the 500yr; 0.2% AEP event will cause nuisance flooding, but regular flooding is less likely.
- Coastal flooding is likely to occur uniformly at Stamps Landing whereas there are two lower points of entry for flooding at Olympic Village near Hinge Park and East Park.
- Compounding impacts of sea level rise and coastal exposure are minimal at both Stamps Landing and Olympic Village. Expected storm surge and wave

- run-up will have a small impact on compounding the effects of sea level rise, however upland flooding has the potential to contribute to flooding concerns along both east and west sides of Olympic Village, and along 1st Ave.
- Assets vulnerable to upland flooding face the most immediate risks to flooding in these areas and adaptation measures must consider flow paths and the intersection of blue-green systems as they outfall into False Creek.
 - Adaptation and investments should respond to the risk tolerance of the various community and infrastructure assets that may be vulnerable to various flood events. The need to protect investments and infrastructure should be assessed based on the vulnerability, risk, and expected lifespan of that element.

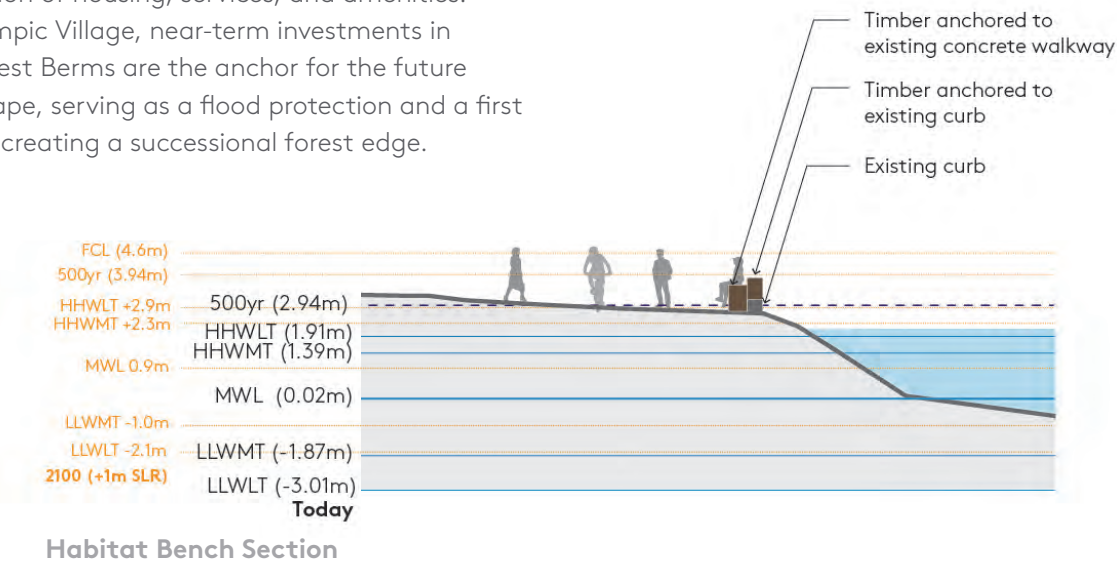
- Key questions to consider for future planning efforts include:
 - How long does this need to be protected for?
 - Is the proposed adaptation and investment strategy affordable?
 - Who is responsible for funding the proposed adaptation and investment strategy?
 - How should adaptation and investment options be prioritized given financial constraints?





Design & Planning Response

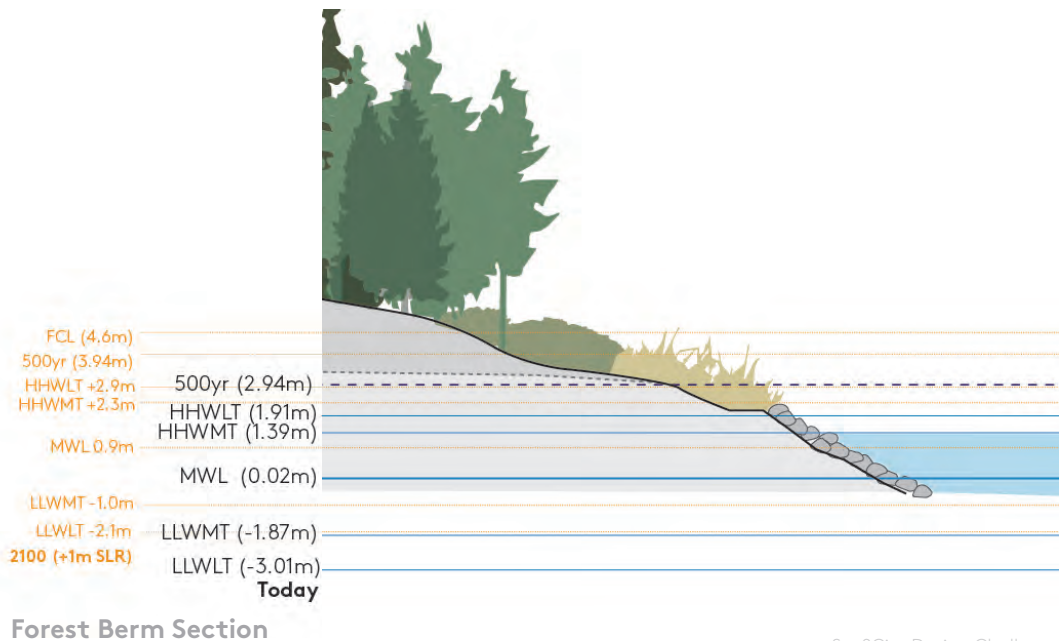
- To address vulnerability, manage risk, and work toward the vision of a decolonized shoreline, development and infrastructure within areas of historic fill or within the floodplain will be incrementally phased out and redevelopment will not occur in floodprone areas.
- Adaption measures are designed appropriately for the time horizon for which they will address.
- Adaptation at Stamps Landing will focus on protecting assets adjacent to the shoreline in the near term with the temporary and adaptable Habitat Bench. Because much of Stamps Landing will not be susceptible to regular flooding in the near-term, the Habitat Bench can protect vulnerable areas until their eventual removal as urban development moves inland.
- Regular flooding is not an immediate concern for much of Olympic Village in the near term. A long-term phased approach, focused on densifying upland areas to the south around the 2nd Ave "Host Corridor", allows for the gradual retreat and relocation of housing, services, and amenities.
- At Olympic Village, near-term investments in the Forest Berms are the anchor for the future landscape, serving as a flood protection and a first step in creating a successional forest edge.



Recommendations & Next Steps

1. Build on and advance work done in the False Creek Coastal Adaptation Plan study.
 - Flooding assessment via SLR mapping using a high-resolution DEM, higher resolution compared to what has been previously used, to resolve the details of the waterfront such as drainage ditches and raised edges or curbs of pedestrian pathway. _
 - Upland flooding assessment evaluating stormwater network under future projections of more intense/frequent rain events coinciding with extreme high tides.
 - Conducting project/property-Specific vulnerability assessments and developing thresholds for when mitigation action should be implemented.

2. Conduct vulnerability assessments for critical community & Infrastructure Assets.
 - Building off of the principles and strategies developed in the Infrastructure Flood Risk Tolerance Document by Compass and Ebbwater, conduct site scale assessments for assets along the shoreline. Starting with low lying and critical infrastructure systems, this will be the first step in an iterative process that will involve: 1 - reviewing sea level rise and upland flooding data as it evolves. 2 - determining the vulnerability of locations and assets to flooding. 3 - understanding risk tolerance of those assets. 4 - planning for mitigation or adaptation of that risk. 5 - Implementing those strategies. 6 - Monitoring the performance of the strategies. And repeating the process as more information and outcomes become available.



Iterative Process for Addressing Risk and Vulnerability

Diagram adapted from San Francisco Sea Level Rise Action Plan.



Vulnerability Assessments are typically the first planning step that identify most vulnerable assets. The second major step is to develop checkpoints/thresholds for when mitigation action should be implemented for each existing asset. In parallel, a code review (seeking feedback from developers among other stakeholders) can inform what incentives can be provided to encourage implementing adaptive measures for new developments in case climate change impacts exceed today's best available science.



Coordination with City Planning Efforts

A fundamental shift in how the City of Vancouver manages development on its lands and how it influences private development is proposed through this work. Realizing a vision for 2100+ that moves housing, businesses, amenities, and community services out of areas that are flood-prone and are built on areas of fill requires political will, community buy-in, and deep and intentional interdepartmental coordination within the City for near- and long-term planning efforts. The vision, values, and goals represented in this work should span across all scales of planning, from city scale work like the Vancouver Plan, down to site specific projects along the shoreline and neighborhoods like East Park and the proposed elementary school at Olympic Village.

The vision of a restored shoreline supports multi-benefit goals beyond coastal adaption and the strategies proposed through Sea2City can support Vancouver's goal of being the greenest city in the world. This work points directly to strategies that address initiatives related to: climate resilience, Truth and Reconciliation, biodiversity, open space and parks, arts and culture, carbon neutrality, zero waste, clean water, and stewardship.. Shoreline and neighborhood adaptation can provide the space for multi-benefit solutions that provide the greatest benefit for all of Vancouver and Musqueam, Squamish and Tsleil-Waututh Nations and further analysis is recommended as a next step.

The Broadway Plan and False Creek South planning are each interconnected with shoreline planning along South False Creek. This work can support, supplement and address gaps in these adjacent planning efforts.

Host Corridor Development Vision

Working toward the vision of a False Creek shoreline that makes space for natural processes, ecosystem restoration, and cultural and community uses requires significant near-term investments in the watershed and adjacent areas. In order to manage flows, clean water, and create vibrant and affordable places for future residents to live, work, and recreate, both physical design and policies must change.

Central to this strategy are proposed changes to the W 2nd Ave corridor adjacent to Olympic Village, the W 6th Ave corridor adjacent to Stamps Landing, and the W 1st Ave corridor connecting Olympic Village to Stamps Landing. 'Host Corridor' is a new neighborhood typology for False Creek.

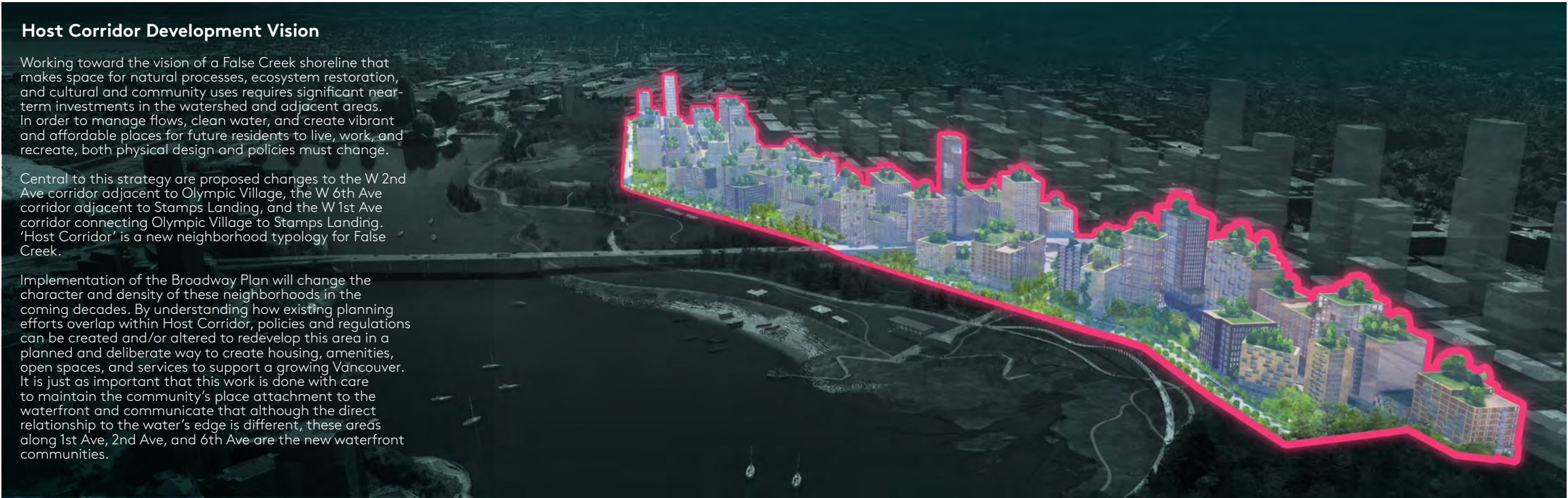
Implementation of the Broadway Plan will change the character and density of these neighborhoods in the coming decades. By understanding how existing planning efforts overlap within Host Corridor, policies and regulations can be created and/or altered to redevelop this area in a planned and deliberate way to create housing, amenities, open spaces, and services to support a growing Vancouver. It is just as important that this work is done with care to maintain the community's place attachment to the waterfront and communicate that although the direct relationship to the water's edge is different, these areas along 1st Ave, 2nd Ave, and 6th Ave are the new waterfront communities.

Findings & Key Issues

- Vancouver is growing rapidly, facing increasing issues of housing affordability.
- There are multiple ongoing or recently approved planning efforts that span across different areas of the shoreline that can be tied together to support a holistic approach to planning within the floodplain. These include: Southeast False Creek, False Creek South, and the Broadway Plan.
- False Creek and its surrounding areas represent an important opportunity for the City to demonstrate climate adaptation in a visible and beloved place: close to downtown, connected (to an extent) by transit, with significant City-owned lands.
- The long-term transformation of False Creek must start now, linking development strategies for upland areas to the waterfront. These areas cannot be addressed separately. Creating density in upland areas creates opportunity to reimagine the waterfront – to ensure that False Creek residents aren't permanently displaced from the area.
- Musqueam, Squamish and Tsleil-Waututh Nations are critical partners in co-designing the vision.
- In reviewing the Broadway Plan, the following opportunities and considerations were identified:
 - Areas along the south side of False Creek, including Stamps Landing and Olympic Village, can support proposed density in the Broadway Plan by providing open spaces and natural areas, connected by improved north/south streets.
 - The area south of Olympic Village is identified as an area that will maintain industrial land use. Given the need to shift density away from the shoreline, future consideration can be given to the character and density of industrial areas within proximity to the shoreline.
 - Established view cones may limit future density in areas adjacent to the shoreline.

Recommendations & Next Steps

1. Continue regular collaborative workshops across departments and internal planning teams to organize ideas around how policy and planning efforts can influence areas within the False Creek floodplain.
2. Assess city-wide opportunities for addressing the density shift that will be required to move away from the shoreline. Although this work emphasizes opportunities directly adjacent to Stamps Landing and Olympic Village, this is only one of many spatial strategies to address the balance between restoring the shoreline and other planning needs.
3. False Creek South planning is an opportunity to increase density in the upland areas which will be critical for providing alternatives for residents and businesses to remain in the neighborhood as sea level rises.
4. Consider subtle shifts in the False Creek South Plan to respond to daylighting streams or introducing hybrid green infrastructure that mimics the function of the historic streams.
5. Revisit height restrictions in the lowland areas. Due to topography, views may not be affected with higher building heights.





Affordability and Place Attachment

Findings & Key Issues

- South False Creek contains a mix of leasehold and freehold properties on city-owned and privately owned lands. These multifamily buildings represent distinct trajectories for adaptation based on the timing of leases and the age of the buildings.
- The City has the ability to effect transition for a limited number of properties – those on City-owned land, as they approach the date of their lease expiration. This is true at select Stamps Landing building sites.
- Olympic Village is an entirely freehold development, which means the City lacks leverage to initiate a transition. Here, the timeline for adaptation is more likely to depend on cycles of capital investment. As sea level rises, and buildings approach the end of their useful lifespan or require major investments, conversations between the City and ownership could lead to preparations for relocation rather

than investing in temporary upgrades. It is not clear what that process might look like, and would potentially require public, private and non-profit sector interventions like buy-outs, transfer of development rights, or land transfers . On-going conversations with property owners is highly recommended to anticipate the need for future collaborations between property owners that are experiencing shared risks.

- Affordable housing is a primary concern of residents in Vancouver.
- When surveyed about climate change a primary concern is losing housing, local businesses and public open space to rising sea levels.
- Addressing access to affordable housing, public space and climate adaptation is difficult to do on a site-by-site basis. Looking holistically at the issue is important to support decisions that can advance all three interdependent issues together

Host Corridor Development

The building typologies in this district are impermanent, designed for deconstruction, are constructed with mass timber technologies and decenter human habitation as the sole function of these spaces.



- Place attachment and sense of belonging is one of the strongest indicators of social resilience in a neighborhood or community. The more people that know each other and can rely on each other in a crisis, the healthier the community is able to be. Supporting place attachment in policies and adaptation strategies has multiple benefits across economic, social and environmental realms.
- Place attachment works across timescales. Musqueam, Squamish and Tsleil-Waututh cultural traditions and stories remain attached to places across Vancouver and False Creek. False Creek was a place where many nations came together because food was so abundant here.

Design & Planning Response

- Densify the upland areas in the South False Creek plan to allow, over time and as policies change, priority support for local residents and businesses to relocate within the neighborhood and out of the floodplain.
- Create a new neighbourhood centre, The Host Corridor” along 2nd Ave and 6th Ave that would support the upland transition of homes and businesses.
- Phased relocation to replace buildings with public space within the historic shoreline

Recommendations & Next Steps

1. Explore the upzoning and viewshed issues during the South False Creek process that would meet current targets and include relocation of current homes and businesses.
2. Explore the transitions necessary between ownership and leaseholds to support successful transfers of land.
3. Explore how the public agencies can support businesses and residents in relocating based on the shared public expenses to do otherwise.
4. Form on-going advisory groups of constituents that can be ambassadors to share technical information with their related groups. When organized to create reciprocal exchange this is an important mechanism for adapting information and strategies for everyone.

"A lot of people that live in the urban environments are disconnected from the ocean and so we have something to offer - our worldview, our lived experiences intergenerationally"

- Chief Dr. Frank Brown
"Decolonizing the Shoreline"
conversation.



Hydrology, Water Quality and Infrastructure

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Findings & Key Issues

- Extensive impervious surfaces and piped runoff act to accelerate delivery of stormwater runoff to False Creek. This altered hydrology has impacts on water quality, flooding, and habitat in False Creek and the floodplains of Stamps Landing and Olympic Village.
- The City's current requirements for rezoning projects is to retain 24 mm of runoff and treat 48 mm from pollutant generating surfaces. The Rain City Strategy sets an aspirational target of retaining and treating a 48 mm event, which is correlated to 90% of average annual runoff. The preferred approach for managing stormwater is green rainwater infrastructure (GRI). As properties redevelop, the installation of GRI on private and public property will provide slow incremental improvement in water quality associated with stormwater runoff. Acceleration of GRI adoption outside of redevelopment timelines will be critical to ensuring that clean runoff is delivered to False Creek to support ecosystem restoration.
- Flooding is already occurring with the existing system when major rains correspond with King tides or even normal high tides in some circumstances. City modeling demonstrates that flooding in the floodplain can be up to 1.2 m in areas like the East of Cambie site, and along 1st Ave near Hinge Park.
- Combined Sewer Overflows - Water quality issues stem primarily from CSOs and untreated stormwater runoff. The City has been implementing a long-standing global sewer separation program that focuses on the renewal of aging assets. The City's sewers connect to Metro Vancouver's regional sewers and CSO outfalls. There are both City and Metro Vancouver CSO outfalls. To date, approximately 50% of the pipes in the City have been separated, though many lateral combined service connections and several major outfalls remain combined, including one at Stamps Landing. To eliminate CSOs, accelerated sewer separation coupled with installation of distributed and centralized stormwater management facilities will be needed in upland areas.
- Historically, several perennial streams flowed down the slopes of the "Little Mountain" at Queen Elizabeth Park to False Creek. As the City developed and grew, all of these streams were buried within pipes, filled in, or otherwise diverted. Currently, there are no natural surface water bodies in the vicinity of Stamps Landing or Olympic Village.
- Restoring natural hydrology of the False Creek drainage basin will entail slowing down runoff, retaining it on the landscape, allowing it to infiltrate and absorb into the landscape as much as possible. This would also entail providing surface conveyance pathways that are analogous to natural stream systems - Blue green corridors - that help safely convey flows (including flood flows) that are in excess of the absorption capacity of the landscape.
- As part of the Broadway Plan, the City is considering a Blue-Green System (BGS) along W 1st Ave and Columbia Street near Olympic Village. Both of these systems would serve to divert upland runoff from the pipe system to help mitigate CSOs, reduce runoff that contributes to flooding, and treat run-off. Ultimate success of BGS will be establishing a continuous rather than a fragmented or piecemeal set of corridors. Logically the City should start constructing the BGS at the downstream end and work upland.

Design & Planning Response

- 1st Ave Blue-Green Corridor
 - For both the Stamps Landing and Olympic Villages sites, the 1st Ave Blue Green Corridor would not only manage flows generated upland but could also serve as a flood protection line to protect upland properties from coastal flooding.
 - City modeling showed that the 1st Ave Blue Green Corridor greatly alleviated flooding extent and intensity at the Olympic Village site (and East of Cambie site) but was most successful in doing so with appropriate outlets to release the water backed up behind the floodwall. Hinge Park is logical location in line with another BGS at Columbia St. So is east side of Olympic Village. The outlet could be elevated weirs, culverts with tide gates, and/or permeable berms along the length of the corridor. A potential pump station will need to be considered south of Hinge Park. Further study is required to determine if the pump station will be necessary.
 - The placement of the flood protection infrastructure is critical. Placing it at or near existing shoreline exacerbates already existing internal-drainage related flooding. Placing it at 1st Ave addresses existing flooding in that area as well as future the near-shore flooding.
- Daylighting historic stream at Stamps Landing
 - The City is planning to construct a new stormwater outfall at Willow Street near Stamps Landing. The outfall is going to be gravity fed from an upland area and as a result will likely be highly pressurized. The City



1st Avenue Blue-Green Corridor

Blue-Green Systems and integrated open spaces tie the watershed to the waters of False Creek through a series of floodable streets that act like sponges, providing diverse habitat for urban wildlife.

- could explore daylighting the outfall further up the Willow St BGS alignment and consider regenerative step pools to slow and infiltrate water prior to the outfall.
- The Willow-Heather Street outfall, which would theoretically be conveying treated stormwater from upland GRI, could discharge a restored stream mouth west of Stamps Landing.

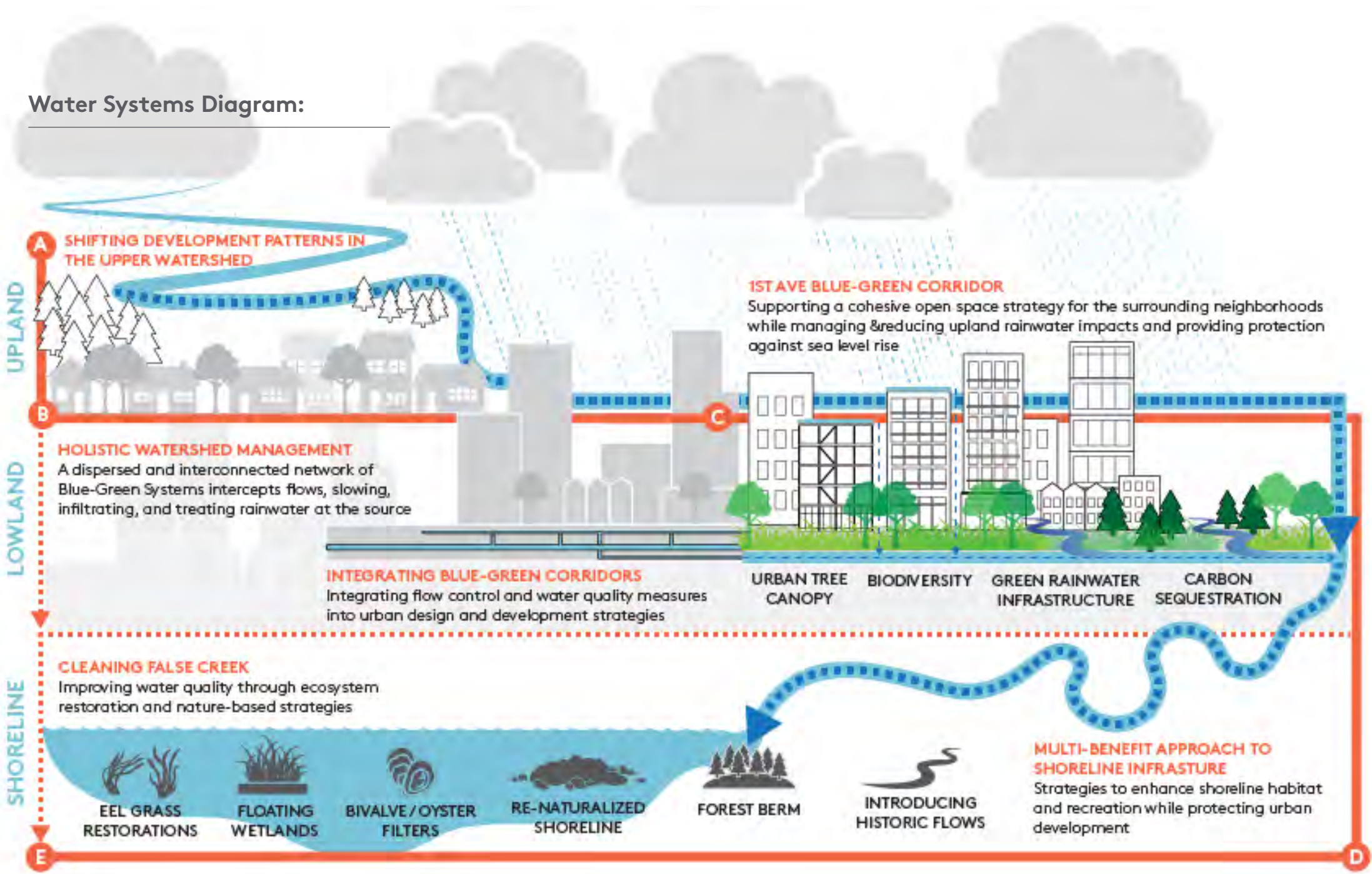
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Recommendations & Next Steps

1. Review and integrate strategies from the Healthy Waters Plan. <https://vancouver.ca/home-property-development/healthy-waters-plan.aspx>
2. Incorporate future stream mouth daylighting into current planning for the proposed Willow Trunk
3. Consider a 1st Avenue Blue Green Corridor Pilot Project that would begin to implement GRI strategies within the right of way, allow for temporary closures of the streets for markets or events, and educate the public on the idea of 1st Ave as the future shoreline.
4. The city should implement as much GRI as possible in the floodplain and upland areas feeding into False Creek. This could take the form of: public GRI implementation, private development-driven GRI implementation, private GRI retrofits.
5. Develop program to mandate or incentivize open space set-asides and green area dedication in development projects in the floodplain and upland area of south False Creek(e.g., Seattle Green Factor Program and Washington, DC's Green Area Ratio)
6. Studies and Investigations - The city needs to continue to improve system understanding. Specific recommendations include:
 - Continue to develop a calibrated City-wide

Water Systems Diagram:



hydrological and hydraulic model inclusive of City pipes and MV Trunks

- Further develop the City's flow monitoring network to inform model calibration and to track system function
- Further develop the City's water quality monitoring network to inform performance of GRI and other water quality programs
- Develop causal models that link human health and ecological endpoints with pollutant load

- reductions, as a means to evaluate ultimate planned project and program effectiveness
- Perform shallow and deep infiltration feasibility and groundwater impacts study to inform future GRI planning efforts in the floodplain.
7. Potential Partnerships - The private realm generally is the biggest potential partner as the area around False Creek and Broadway redevelop.
- Create a consortium of City-wide public and

private partners to share knowledge and to coordinate and leverage GRI implementation activities.

- Conduct a study to evaluate the potential for implementing community-based public-private partnerships (CBP3) for GRI retrofitting in the south False Creek area.
- Develop property-owner award and recognition program to promote and acknowledge private GRI investments



2100+ Vision for Olympic Village Mud Flats

Restoring Target Ecosystems

The physical design of waterfront infrastructure cannot be static due to the uncertain nature of climate change, sea level rise and changing regional storm patterns. Adaptability must be built into the project planning process and physical design of specific sites along the shoreline. Science related to the impacts of sea level rise and storms is being updated constantly, and a design scenario and target ecosystem defined today will likely not be the same 20+ years from now.

It is critical to redefine the design metrics and risk tolerance thresholds for shoreline environments as the data evolves. Feedback from Collaboratoriums and community input heavily favored the use of green solutions over gray for new shoreline infrastructure. A suite of natural shoreline features, from in-water habitat to upland habitat, has the ability to be more responsive and resilient to changing conditions than a hard armored shoreline.

Natural coastal ecosystems provide an environmentally sensitive solution to shoreline protection, promoting resiliency through natural processes that can restore

damaged habitat, filter the water, enhance local fisheries and promote human interaction between land and water. A living shoreline, from the upland forest to the deep-water kelp beds, are an integral part of the vision for False Creek. Wetlands can sequester carbon, beaches can dampen wave impacts, creek mouth restoration can provide natural replenishment of beaches, and clam beds can improve water quality. These natural coastal processes achieve multiple benefits at a fraction of the cost and maintenance of structures once established.

The intent of the vision is not to explicitly define the future habitats and ecosystems that will be established by 2100. There are many factors, adjacencies and interdependencies that will emerge and evolve through shoreline and upland investments that will influence which target ecosystems will be successful or be able to establish and adapt as a regenerative ecosystem.



2100+ Vision for Stamps Landing Tidal Marsh

Findings & Key Issues

- Determining target habitats should be done alongside Musqueam, Squamish and Tsleil-Waututh Nations so that the cultural value and historic presence of ecosystems are prioritized during planning.
- Planning for ecosystem restoration or construction should consider the rate at which sea level rise is advancing and account for planned or natural habitat migration.
- Tidal flushing within False Creek has been greatly reduced over the last century due to a combination of impacts. The overall tidal prism of the False Creek embayment has been greatly reduced due to in-filling and shoreline simplification. Tidal flushing has been further altered by the reduction in freshwater flowing into the basin and the transition to more flashy hydrology with little consistent flow. These impacts are most pronounced east of the Cambie Bridge where the channel is substantially narrower and roughly half its historical extent. The ecology of this area is also degraded by the toxic legacy left behind from decades of heavy industry.
- An adaptive management and flexible investment plan will be necessary to be able to respond to and make space for uncertain outcomes.
- Future habitats and ecosystems are reliant on a number of water quality and hydrological considerations as investment occurs including:
 - Potential for increased tidal flushing and flow within False Creek
 - Contribution of clean water and flows from upland outfalls and restored historic streams
 - Contribution and management of sediments and woody debris
 - Presence of contaminated sediments and groundwater
- Collaborate with Musqueam, Squamish and Tsleil-Waututh Nations to develop management, maintenance and monitoring strategies to protect investments and ensure healthy ecosystems through adaptive management



Design & Planning Response

- The habitats and ecosystems presented in the 2100+ vision represent a range of ecosystem types including:
 - Forest Berm - the berm will function to cut off the flood points of entry along the shoreline and serve as the anchor for future phases of renaturalizing the waterfront. Cedars will act as the foundation for a landscape that will evolve with the changing water levels and climate. The use of Cedars is directly tied to a landscape where Musqueam, Squamish and Tsleil-Waututh people see their values reflected. These habitat areas can be used as an educational space to express these cultural connections.
 - Upland Forest - Investments in pockets of forest habitat can serve as the anchors for the shoreline landscapes as they change over time. To reestablish mature tree canopy in these areas, a vision of a restored urban forest requires early investment in successional planting strategies that will support these habitats in a changing climate. Climate adapted species should be prioritized.
 - Tidal Mudflat - Removing fill from the Olympic Village area allows for the creation of tidal salt marsh, referencing back to the mudflats that were historically present here. This area will be accessible for harvesting and foraging and will include clam gardens.
 - Gravel Beach - There are opportunities for beaches at both Stamps Landing and Olympic Village. Large intertidal gravel beaches with a waterside habitat bench can replace the hardened shoreline and be used for community based recreation, growing food, harvesting, and for boat launches.
 - Eelgrass Beds - Can be reestablished when sediment and water quality issues are remediated. By restoring the bathymetry to a shallow gradient, space can be made for the gradual migration of eelgrass beds as depths change with sea level rise.
- Daylighting Streams - When the Heather combined sewer is separated at Stamps Landing, the outfall can be restored to stream and marsh habitats, restoring the multiple historic streams that once flowed near this location.
- These ecosystems are not stagnant in time. The approach to restoration will be incremental, phased, and focused on ecological succession processes.
- The establishment and long term success relies on interconnected restoration, cleanup, and watershed management to reduce the impacts of urbanization specific to False Creek. Strategies to begin to address this include:
 - Focusing on upper watershed improvements and drainage infrastructure first so that sub-tidal and intertidal ecosystems can thrive in clean water
 - Remediate sediments in the basin to address contamination issues and study the impacts of dredging
 - Convert rainwater outfalls into restored stream marshes
 - Use Clam Gardens and other bivalve based habitat installations to provide sub-tidal habitat for clams and intertidal habitat for oysters that will clean water in the near-term. Management of Clam Gardens, using traditional ecological practices should be completed through Musqueam, Squamish and Tsleil-Waututh partnerships.
 - Utilize temporary flood protection measures like the Habitat Bench as future habitat structures that nourish and replenish ecosystems to work toward a more closed loop ecosystem typology
 - Develop a co-design and co-management process with Musqueam, Squamish and Tsleil-Waututh Nations to address management, maintenance and monitoring considerations including: when, who and how harvest may occur in these landscapes; balancing human impacts and presence with ecosystem function



2100+ Established Urban Forest

Recommendations & Next Steps

1. Model Tidal Flushing. Using a tidal hydrodynamic modeling such as Delft3D FLOW, model the constrained tidal flushing into the head of False Creek. The modeling effort would require high resolution bathymetry and tide gauge data. Flow measurements should be conducted to validate modeling results. By modeling existing tidal flushing, information will be gathered that will inform ways in which to design restoration and subtidal sediment remediation approaches, without further reducing tidal flushing. This analysis could combine analysis aimed at improving water flow and quality within the greater watershed that would further benefit flushing and further address contamination issues in the basin.
2. Conduct a remediation study. This study will identify existing/legacy contributors of contamination to False Creek and provide recommendations for next steps for cleanup and rough order of magnitude cost associated with various alternatives for the cleanup such as placing a sediment cap and dredging and disposal.
3. Partner and coordinate with Fisheries and Oceans Canada (DFO) to develop a strategy for sediment remediation in False Creek.



Next Steps Toward Implementation

Critical Path Items

Each of the previous sections provide a number of recommendations specific to those topics and provide an overview of studies, regulatory considerations, and partnerships needed to address data gaps and define strategies that work toward the vision for False Creek. Fundamental to a decolonized approach is avoiding maladaptation and investments in strategies that do not ultimately target a restored and repaired False Creek. In advancing this work in the near term, there are a number of critical decisions and planning efforts that will be initiated which need to be informed by more data and established partnerships. In prioritizing these efforts, enough time can be built into the planning process to build the community capacity, regulatory frameworks, and political will for these far reaching, significant projects to be enacted at the right times and in the time frame that proactively addresses the urgency needed to address sea level rise in a decolonized way.

These priority recommendations are categorized into Partnerships, Studies/Site Explorations, Regulatory/Planning, and Pilot Projects and are intended to provide initial draft guidance to generate discussion and refinement by the City about chronological steps that can support a five-year plan of action.



Partnerships

1. Prioritize engagement with Musqueam, Squamish and Tsleil-Waututh Nations, practitioners, and individuals in leadership roles in planning, design, implementation, and management of this work. The pilot projects offer an important near-term opportunity to explore co-design, traditional ecological knowledge, ethnobotany, art and woodcarving, stewardship and co-management with Musqueam, Squamish and Tsleil-Waututh peoples.
2. Establish a property owners working group to share studies and investigations, policy considerations and exchange the status and process of decision making. For example, an East of Cambie working group could include multiple departments that interact with the site; the property owners that rely on the energy generated on the site; the Parks Board, Musqueam, Squamish and Tsleil-Waututh and Youth Adaptation Lab or a youth representative.

Studies/Site Explorations

1. Understand the upfront and long term costs of both no-action and maladaptation approaches to develop a business case for the proposed adaptation approaches for Olympic Village, Stamps Landing and all of False Creek. These studies should go beyond a basic understanding infrastructure and maintenance costs, and in addition quantify social and environmental impacts that reach beyond the site boundaries.
2. Contamination & Remediation Studies. Identify the range of sources of pollution and assess scale and relationship of issues associated with this contamination. A rough order of magnitude understanding of the issues will assist in guiding technical responses. Investigate the impact of rising groundwater on contamination migration on land and in water. The purpose of understanding this is to determine potential impacts on groundwater resources, human health and marine and terrestrial species. Findings of this assessment can be shared as part of transparent community dialogue and continued adaptation strategies.
3. Conduct vulnerability assessments for critical community and infrastructure assets. Identify most vulnerable assets along the shoreline and develop checkpoints/thresholds for when and if mitigation action should be implemented for each asset.
4. Improve stormwater system understanding and identify overlaps between currently planned investments and future shoreline adaptation strategies including introducing blue-green systems and daylighted streams within the floodplain. Projects that are investing in significant infrastructure that will last multiple decades should be planned, updated, or modified to align with the vision for a restored False Creek.

Regulatory/Planning

1. Integrate local place attachment and affordability management strategies into planning and land use policies. To support the current and historic businesses and residents, including Marina users and residents, as well as provide a platform for the integration of Musqueam, Squamish and Tsleil-Waututh opportunities, policies should be considered that incentivize the preservation of local businesses and residents in areas of redevelopment near the shoreline through supported relocation within the surrounding neighborhood.
2. Create a framework for creating effective community-based public-private partnerships (CBP3) as a mechanism to support district-wide investments in open space creation/restoration and the integration of district-scale green rainwater infrastructure systems. In order to tie investments in the upland and upper watershed to improvements along the shoreline, these regulatory processes can help bridge the gap between physical locations and leverage the multi-benefit nature of neighborhood scale solutions. This may take the form of developer incentives or a fund similar to a mitigation banking strategy.

Pilot Projects

The purpose of the pilot projects is to continue growing awareness of climate change issues; test ideas; practice adapting as a City and community; and tangibly demonstrate the truth and reconciliation work with Musqueam, Squamish and Tsleil-Waututh prioritized in this project.

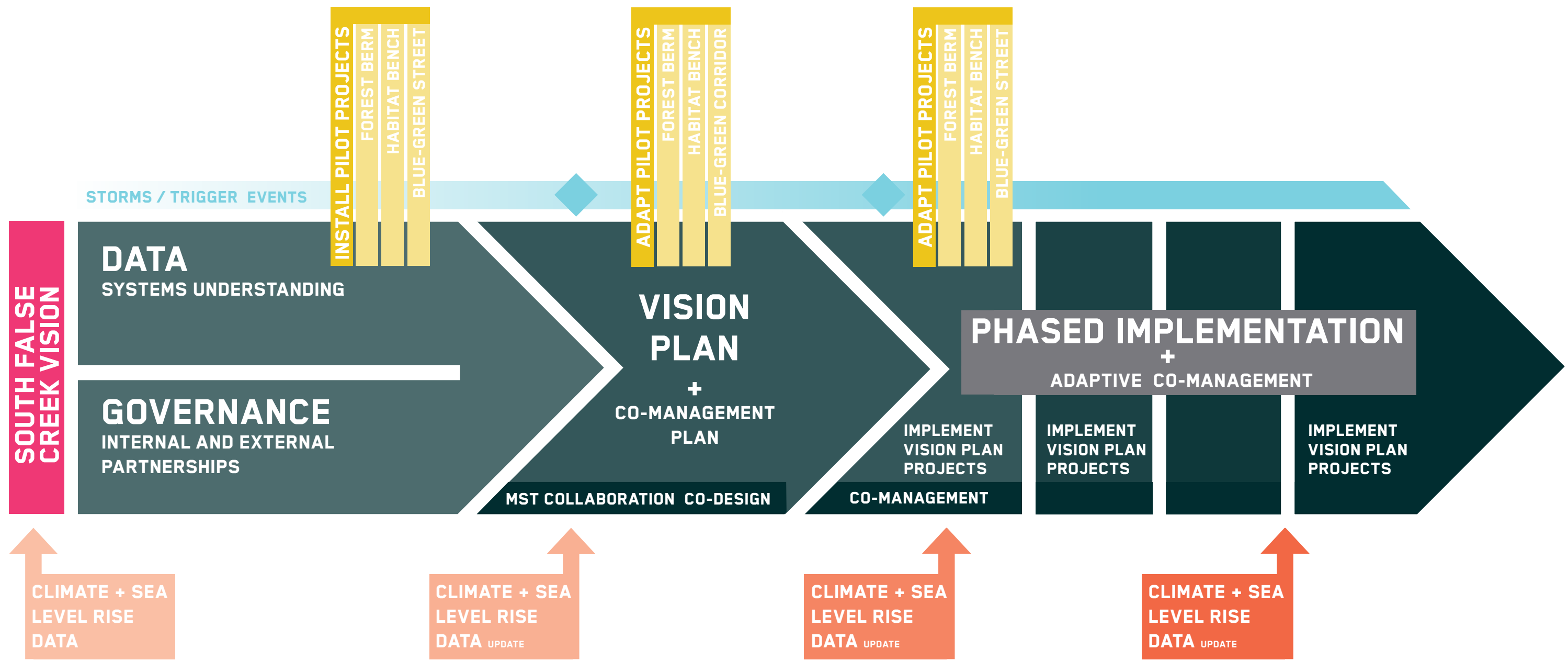
- Establish process for engaging Musqueam, Squamish and Tsleil-Waututh Nations advisors in pilot projects.
- Revisit proposed locations, confirm location conditions and additional studies needed.
- Develop and implement pilot projects
 1. Habitat Bench - demonstrates change and adaptation over time and engages artists to tell the story of sea level rise.
 2. Forest Berm – creates an urban landscape patch that demonstrates climate adapted landscape and integrates Musqueam, Squamish and Tsleil-Waututh Nations values and cultural practices
 3. First Ave Blue-Green Corridor – initiates the connection between upland stormwater flow and sea level rise adaptations at shoreline. Further investigate blue-green system potential and implement a pilot (ideally at the intersection of 1st and Columbia St)



Next Steps Diagram:

The initiation of pilot projects will depend on when opportunities arise. Storms and trigger events might alter the shoreline to the extent that a pilot project becomes a necessity, or funding might provide opportunities for immediate implementation of these projects.

As pilot projects are completed, contributing to the greater waterfront vision and vision, design goals, data, and lessons learned will be refined such that each subsequent pilot project will build upon the previous work, creating a comprehensive shoreline design, working toward the vision.



Regional and local climate and sea level rise data will continue to improve as False Creek planning progresses. Refined data will need to be reassessed and incorporated into the design process to inform the pilot projects, vision plan, and implementation.

As climate data is refined, site and waterfront studies and investigations are completed, and potential projects are identified, the confidence around the potential impacts of sea level rise and risk tolerances will improve. Project and site specific design perimeters should be defined or redefined as this confidence and understanding grows.

Adaptive Design Brief—

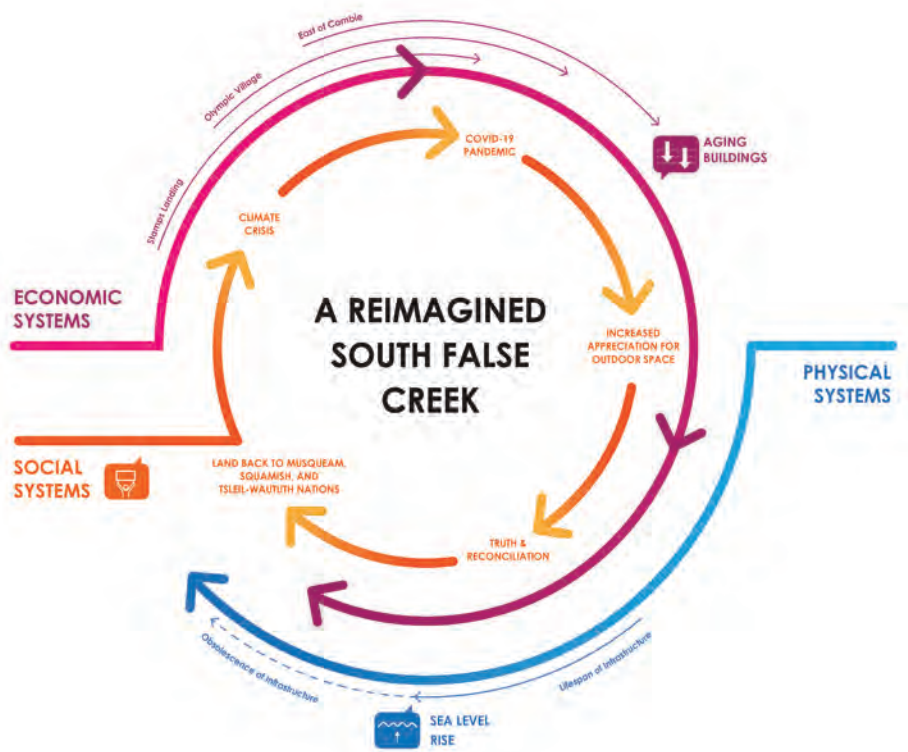


Adaptation Approach

These shared experiences are fusing social issues and climate adaptation issues in an unprecedented way.

Adapting South False Creek to address sea level rise is an iterative, long-term process that requires beginning to plan and collaborate today. It is a challenge that can become an opportunity for the City of Vancouver: adapting to climate change will be the impetus for shoreline restoration that centers the knowledge and stewardship practices of Musqueam, Squamish and Tsleil-Waututh Peoples, renews the relationship between city and nature, and supports vibrant upland neighborhoods. Building an understanding of resilience and creating the capacity to adapt starts today.

While it is uncertain how the process will unfold, there are clear drivers that will play a role in advancing adaptation: the economic realities of aging building stocks and their capital investment cycles; the infrastructure constraints of utility and drainage systems, with a functional lifespan linked to sea level rise, and an evolving social context for decision making, shaped by recent experiences including the Covid-19 pandemic, the Truth and Reconciliation Commission, and the climate crisis.



Adaptation Process Diagram
The process of reimagining South False Creek will be an integrated and iterative process, addressing multiple systems iteratively, as the understanding of SLR impacts grows along with the political and social will to make meaningful change to how the shoreline is managed.

Planning Beyond 2 Meters

There are a many factors that must be considered when determining design criteria for future flood construction level elevations and what strategies projects should use to meet those levels. Relative sea level rise projections are based on two major factors:

- Carbon emissions scenario
- Time period

In addition to the determining the potential rise in sea level for various planning horizons, site specific conditions and localized events will have an additive impact on top of sea level rise. These include:

- Tidal influence
- Interannual-seasonal effects
- Storm surge
- Upland hydrology

These additional impacts will be site specific and can compound depending on specific storm events. These types of events will lead to overtopping, erosion and destabilization of land and infrastructure along the waterfront.

Because projected sea level rise is a range based on probability of occurrence, sea level rise cannot be considered as one set number but must be determined in the context of risk tolerance and compatibility of uses, with an understanding of the anticipated lifespan of the project or infrastructure. For new infrastructure

with a long lifespan, where a loss would be catastrophic or where there is limited flexibility for adaptation, there is little tolerance for risk, and the highest scenarios may be appropriate. Where a project is expected to have a short life span, require little infrastructure, or have the flexibility to make alternate choices, the tolerance for risk is relatively high, and the lowest scenarios may be appropriate.

The current flood construction level, planning for 2100 and 1m of sea level rise is 4.6m. Planning for 2m of sea level rise or more involves planning for higher flood construction levels but this planning needs to go beyond raising the flood construction level incrementally as a direct response to sea level rise potential. Designing to that standard is very safe, but may prove to be prohibitive in terms of implementation costs and feasibility. As the science of sea level rise projections evolve, the understanding of project specific risk tolerance is refined, and urban design typologies become more responsive to living with water, new design standards will have to respond accordingly and the idea of a flood construction level may change altogether.

Each new project must develop and refine baseline standards and risk tolerances based on current data in order to be resilient to sea level rise. This will ensure that forward thinking, longterm solutions will be implemented, maintaining a functioning waterfront capable of becoming self-regenerating while serving the needs of future generations.



Scalability Considerations

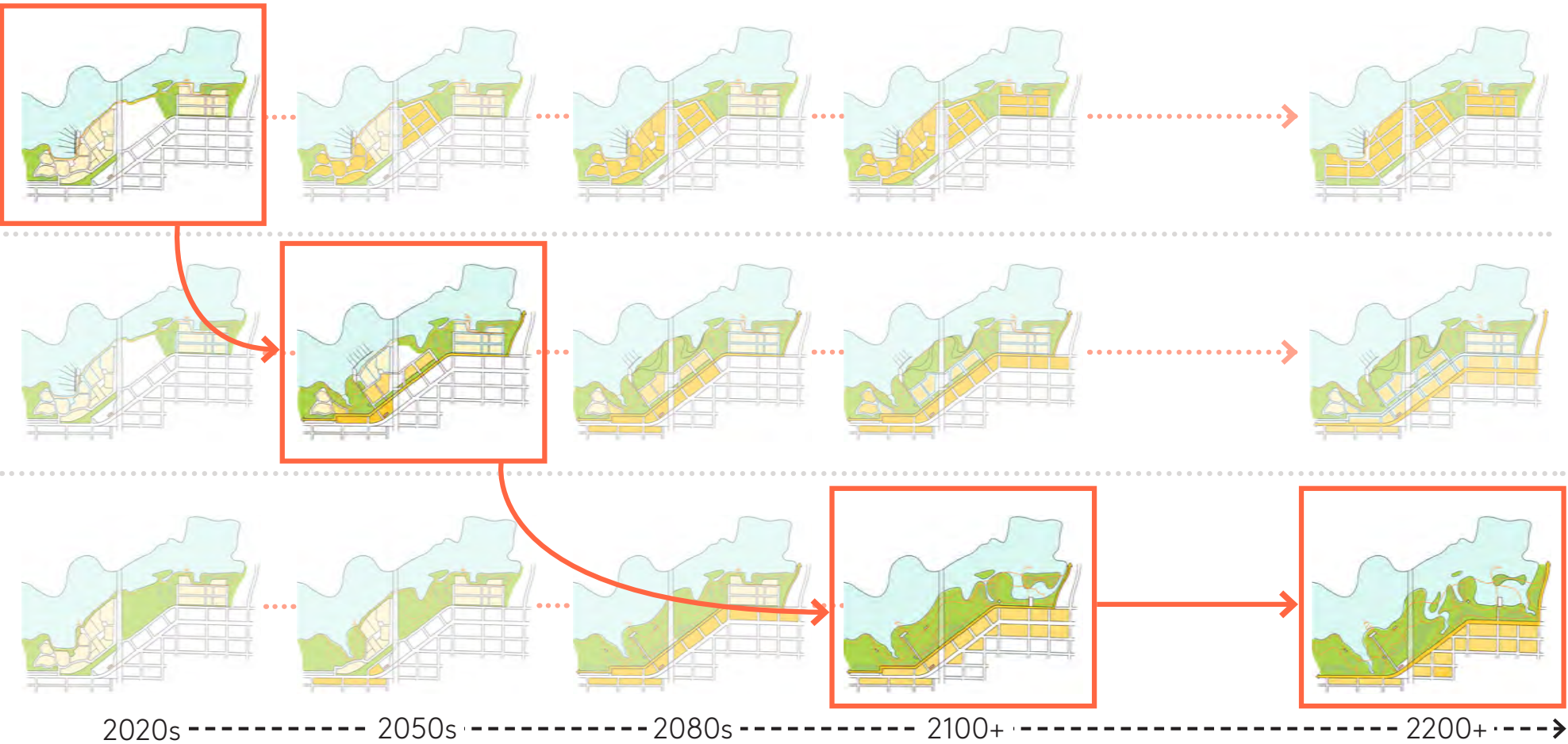
An overall vision for False Creek needs to be established based on the principles, knowledge, and values defined through the exploration of the 5 challenge sites. The philosophy for decolonization, development, and flood management must be aligned so that site specific strategies and planning efforts occurring at different times work toward the same vision.

When considering the overall approach for adaptation of False Creek, it will be necessary to study the opportunities and constraints iteratively between scales; thinking about how responses at individual sites address issues for both the site specifically but also for the False Creek district and all of Vancouver.

The Mithun+One approach to a decolonized False Creek shoreline emphasizes strategies that prioritize the restoration of the landscape in the near and long term, while indicating the need to move development and human impacts out of areas of fill. This makes space for restoration of ecosystems like mudflats and stream daylighting. While this may make sense for areas like Stamps Landing and Olympic Village at different points in time, these strategies and target ecosystems may not be the right fit for the north side of False Creek or other sites along the east west gradient. Each site has adjacencies and relationships that may point to it's best function. There is some urgency in understanding how the vision will inform that work going forward as current and future projects may be executed in a way that compromises the vision, investing in maladaptation.

Planning for Uncertainty

The scientific understanding of the pace of sea level rise is still evolving. Adaptation takes time, and communities need to begin today to “build the muscle” and set planning in place for the long term. Adaptation is a process with multiple drivers, both physical and social, that will play out over time. Working toward an overall vision recognizes that the impetus for change may be different at different moments across the South False Creek site and flexibility must be built into both the process and the proposed strategies. Just as the path to restore the land and adapt to the future, cannot rely on the approach that created the problem, the technologies and approach will no doubt change over the coming decades. Space needs to be left for those shifts to play out. Although things will change, and there is uncertainty in risk, steps must be taken to move toward implementation, not allowing that uncertainty to stagnate the process.



Adaptation Pathways

There are many pathways to get from 2022 to 2100 and beyond. It is impossible to predict all of the planning efforts, regulatory changes, physical and social triggers, etc. that will push the City of Vancouver to define a new relationship with the water along the False Creek Shoreline. That starts with defining a vision. A vision for 2100 provides a target to start working toward. Although there are many pathways to 2100, investments along the shoreline must be planned and completed with the intention of working toward the vision. This involves potentially changing building practices and redefining risk tolerances so that if investment happens in the short term, it is either in alignment with the vision or it is constructed in a way that doesn't preclude the vision. This is potentially a shift from long term investments to short-term, adaptable elements, design for deconstruction.

The risk of maladaptation is that it pushes the ability to realize the vision even further into the future.



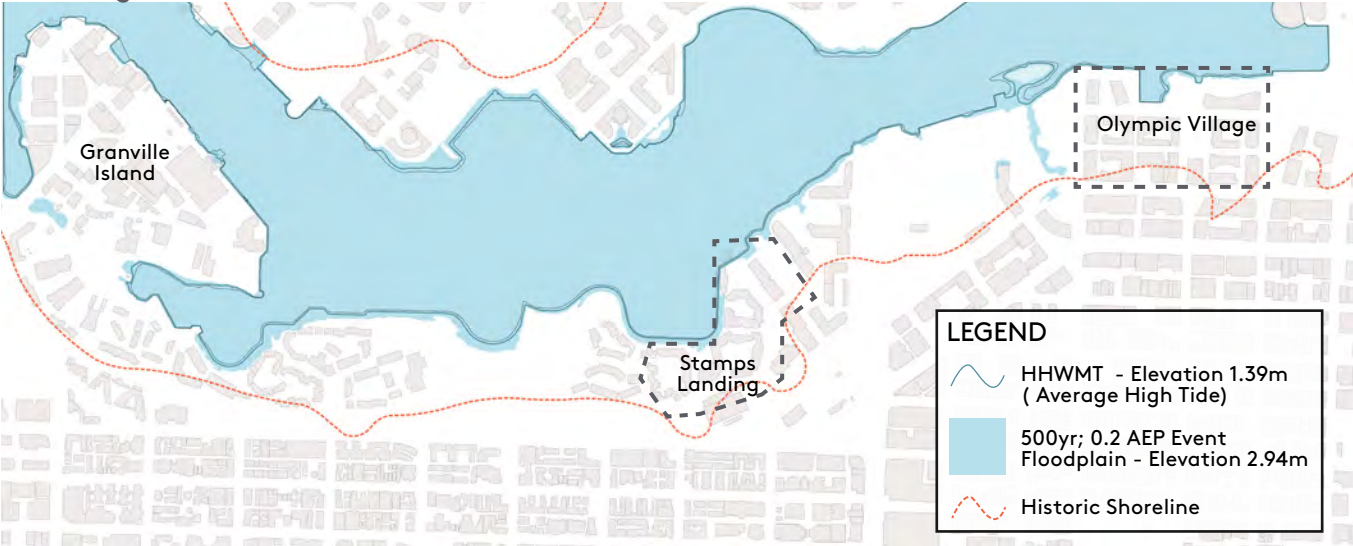
Adaptation Approach: Olympic Village to Granville Island

Following the approach and vision defined for Olympic Village and Stamps Landing, the approach for the flood control ribbon west of Stamps Landing, connecting to Granville Island is to incrementally invest in upland infrastructure, planning for the future, while at the same time strategically moving developments away from the shoreline, making space for the restoration of ecosystems and reconnecting Musqueam, Squamish

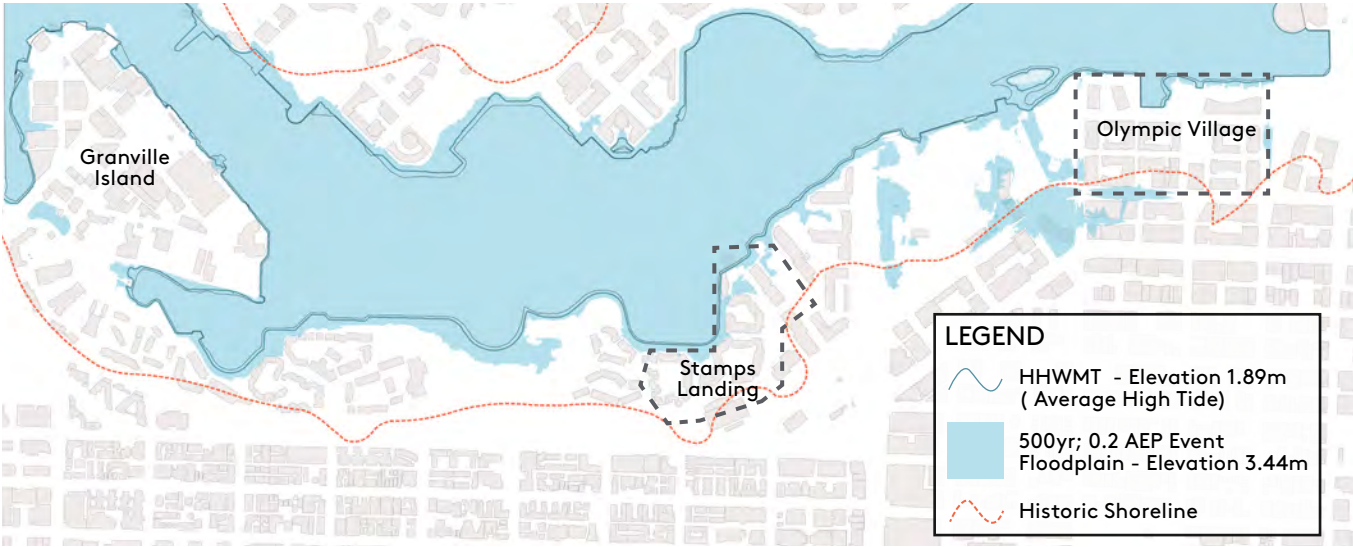
and Tsleil-Waututh Nations to these spaces for cultural use. Although the series of diagrams focuses upland development within Host Corridor, these shifts should focus on city-wide planning.

The following series of diagrams demonstrates how sea level rise, up to 2m, will impact the existing shoreline between Olympic Village and Granville Island.

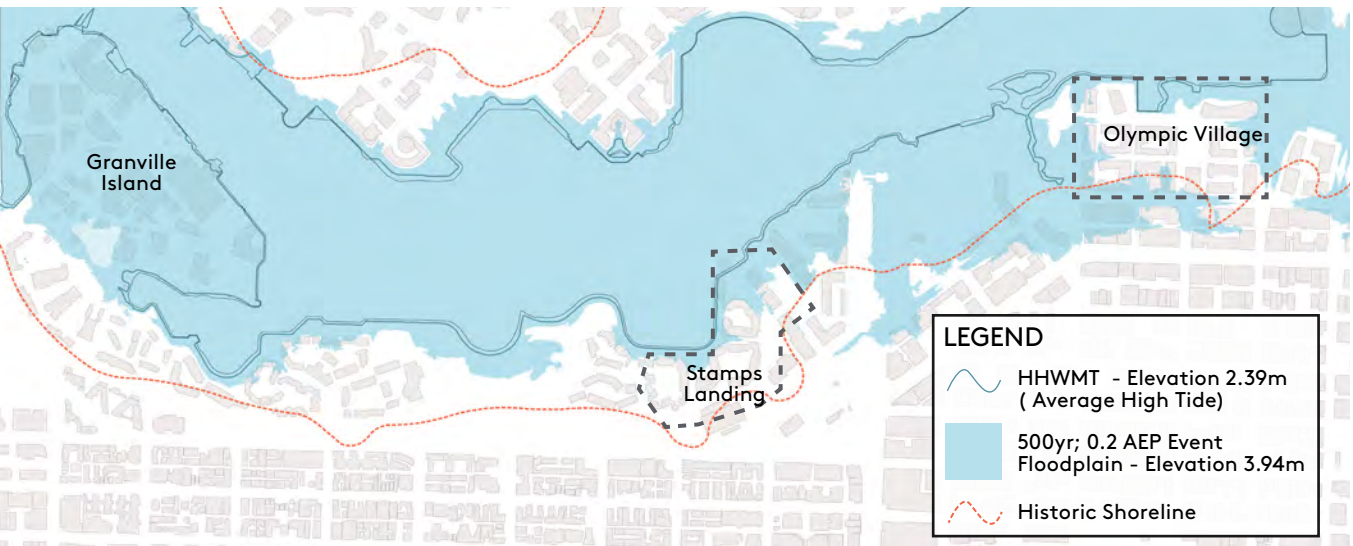
1. Existing Conditions



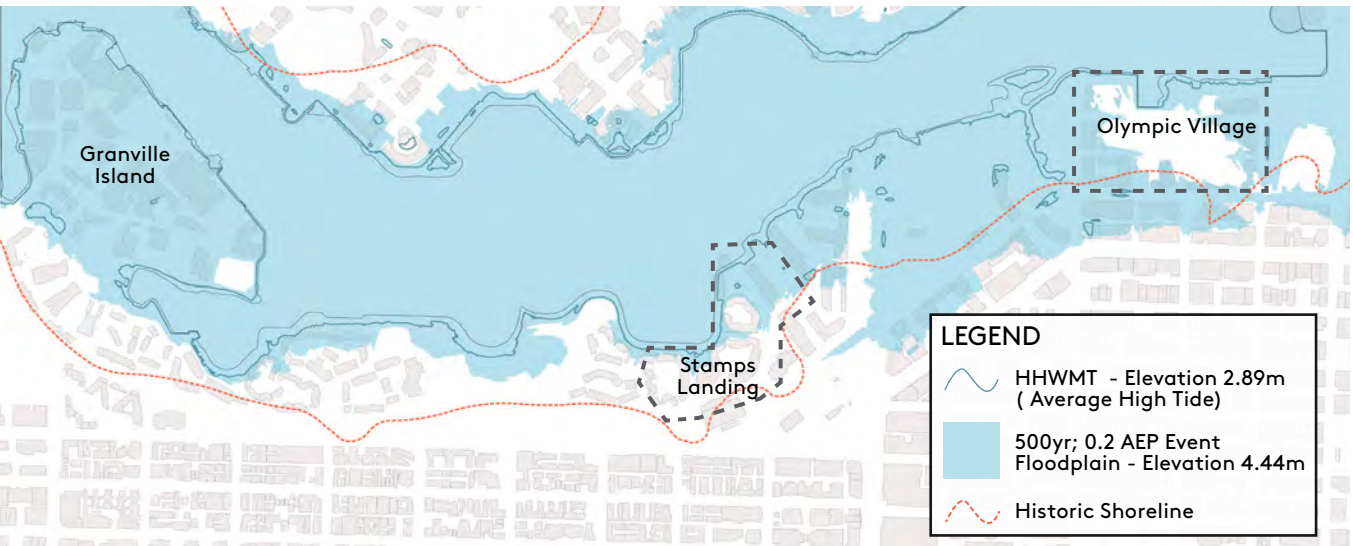
2. 0.5m Sea Level Rise



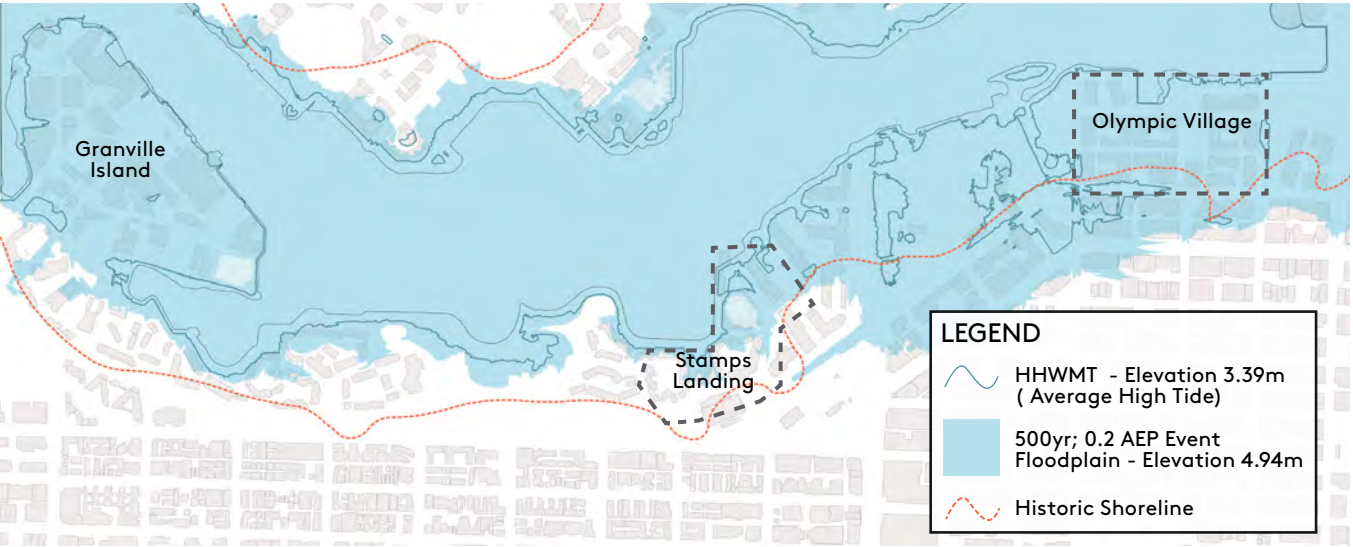
3. 1.0m Sea Level Rise



4. 1.5m Sea Level Rise

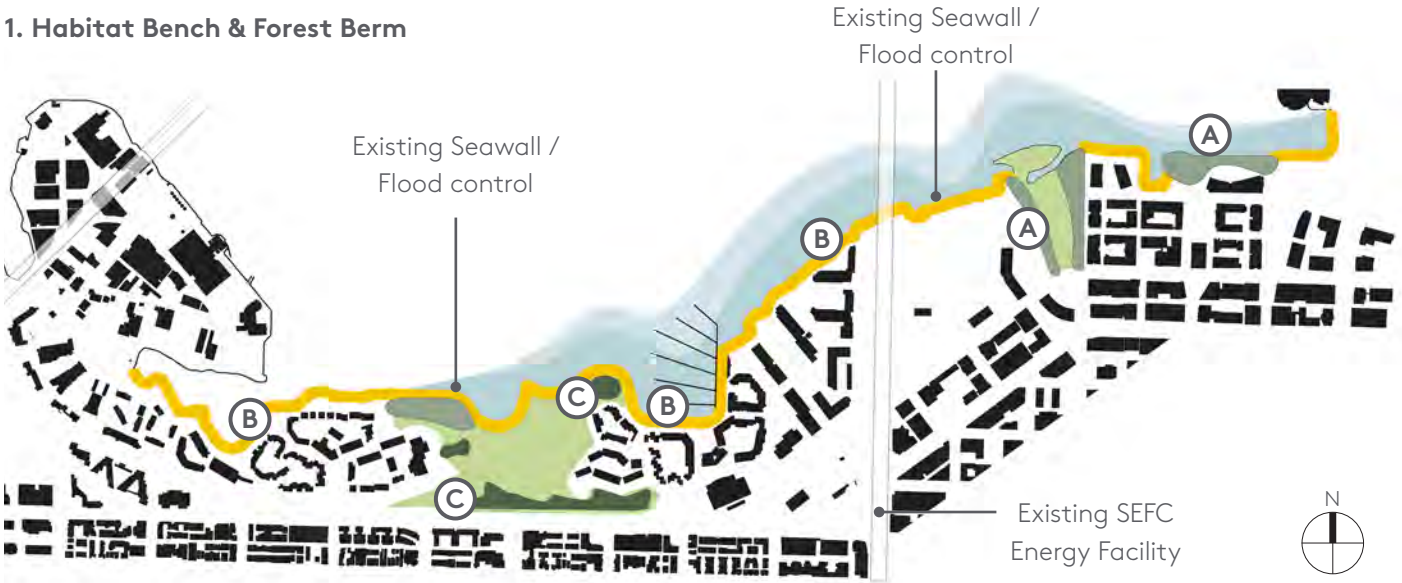


5. 2.0m Sea Level Rise





1. Habitat Bench & Forest Berm

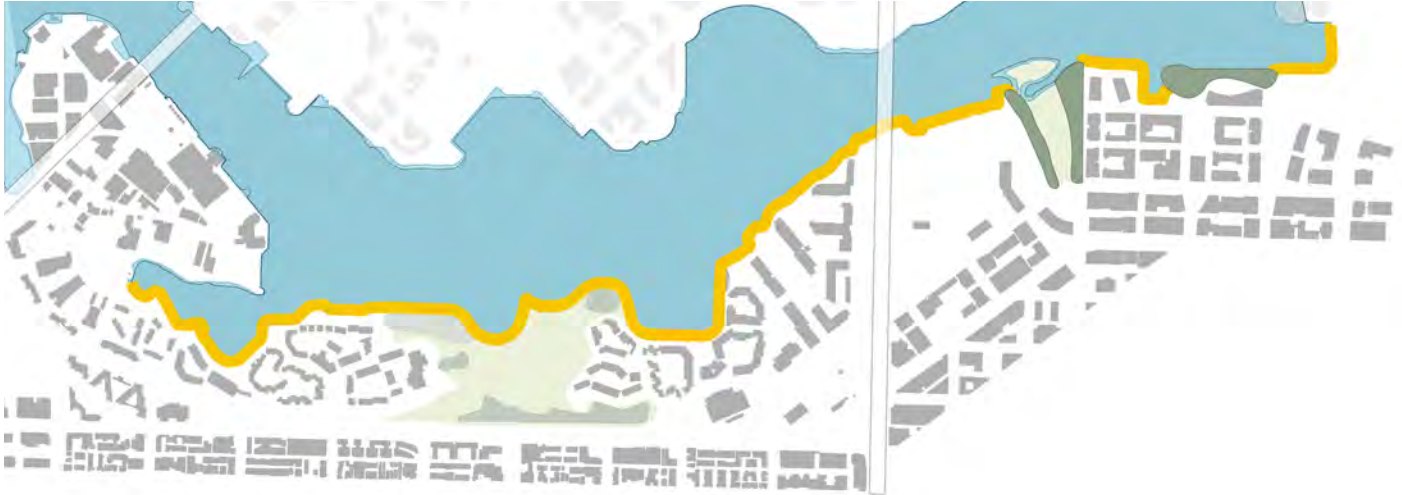


After the establishment and testing of the habitat bench and forest berm pilot projects, they can be applied more broadly around the False Creek basin if they are determined to be feasible and appropriate strategies. The existing seawall will provide adequate protection against sea level rise impacts in the near-term and it can be retrofitted with forest berm and habitat bench installations to provide protection as needed adjacent to floodprone buildings.

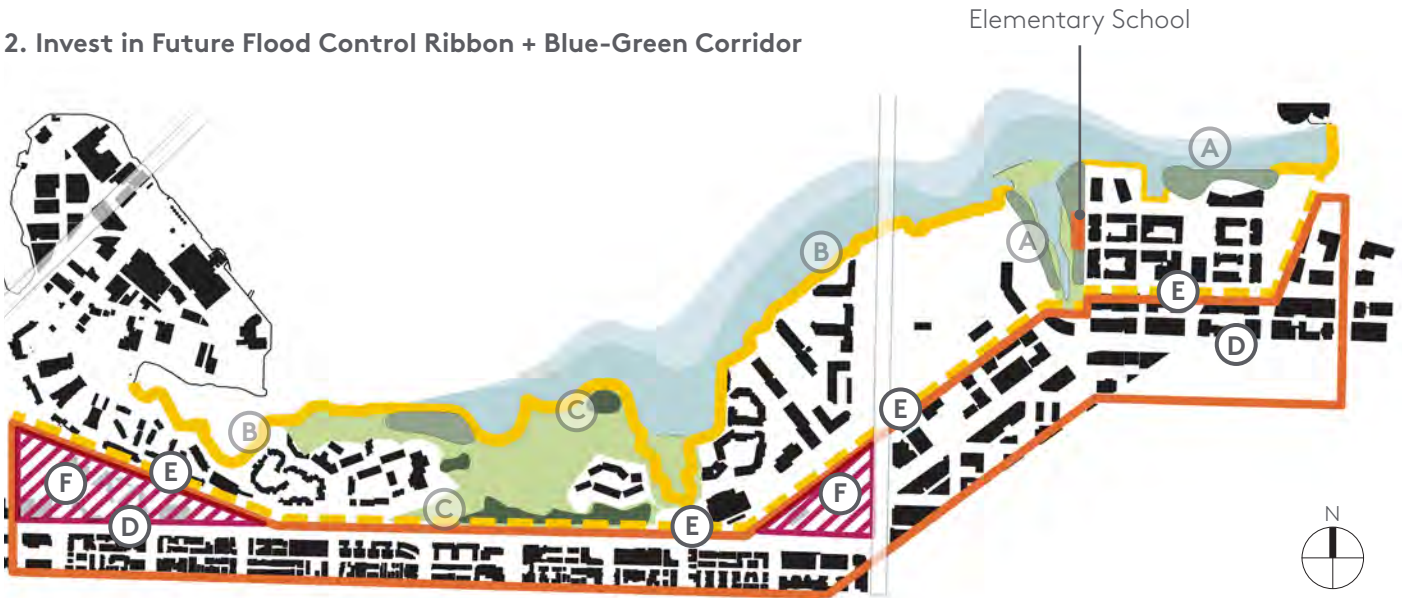
- (A) Forest Berm - located at identified flood points of entry
- (B) Habitat Bench - retrofit existing seawall where structures or infrastructure needs to be protected in the near-term
- (C) Existing Berms - areas of high elevation

Existing Conditions - 500yr; 0.2% AEP Event Overlay

Community assets are at minimal risk to tidal or storm impacts in based on the sea level in 2022. The Habitat Bench & Forest Berm provide protection against rare large storm events and are installed in anticipation of a future with higher sea levels.



2. Invest in Future Flood Control Ribbon + Blue-Green Corridor

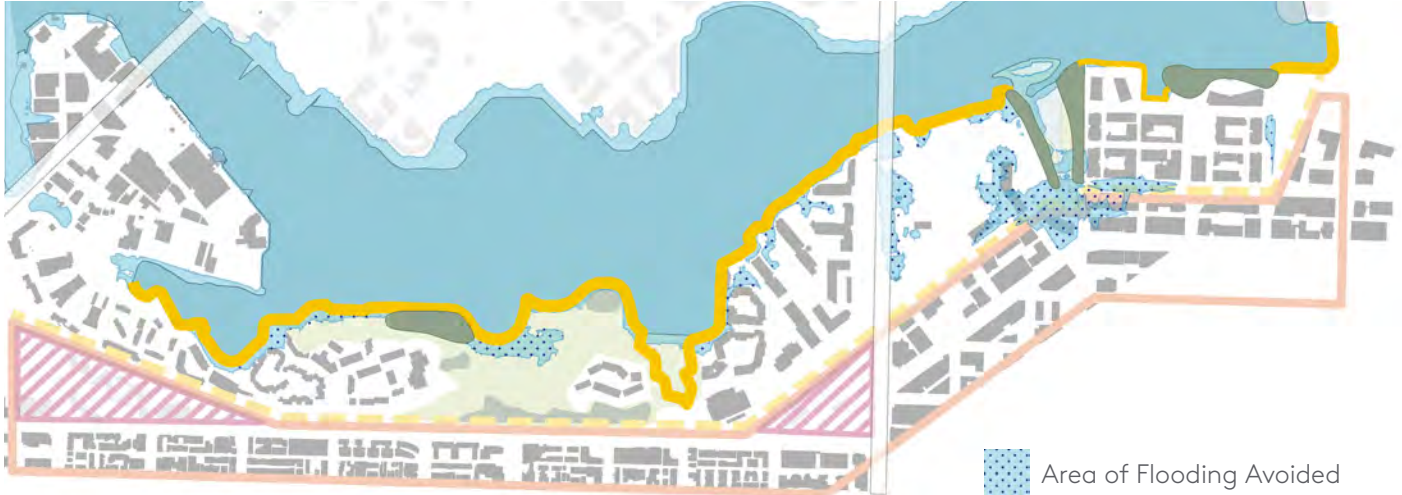


Planning for and investing in upland strategies to prepare for the longer-term impacts of sea level rise should begin in the near-term. Planning for density shift and a different relationship with False Creek is a generational change that will take significant time to build community understanding and to work through the regulatory process. Planning considerations should include an understanding of density needs given the future shift of development out of areas of fill. This density does not need to be accommodated within Host Corridor and should be coupled with city-wide planning efforts. The Blue-Green Corridor, which will serve as the future flood control ribbon is a priority, and should be planned in partnership with private developers to increase the ROW and make the space needed to implement this strategy.

- (D) Host Corridor - planning for greater density in the future
- (E) Blue-Green Corridor - future flood control ribbon connected along 1st Ave & Lameys Mill Rd
- (F) Future Upland Development Areas - planning for increased density

0.5m Sea Level Rise - 500yr; 0.2% AEP Event Overlay

With SLR increasing to 0.5m, some community assets that would be vulnerable in Stamps Landing and near Hinge Park are protected by the Habitat Bench and Forest Berm. Initial investments in the Blue-Green Corridor improve flooding along 1st Ave.





3. Incremental Retreat + Integrate Blue-Green Systems



1st Ave and Lameys Mill Rd are established as the new flood control ribbon. Some past flood control elements like the existing seawall, forest berm, and habitat bench provide protection for pockets of development that remain north of the flood control ribbon, but the continuous flood protection strategy has shifted. Floodprone buildings susceptible to nuisance flooding are retrofitted. At the same time, upland investments in watershed management allow for the connection of Blue-Green systems into the shoreline, providing flows and clean water needed to support ecosystem restoration. Upland development areas are being planned and areas of new development are constructed using strategies that accommodate flooding, working toward an adaptable district within Host Corridor.

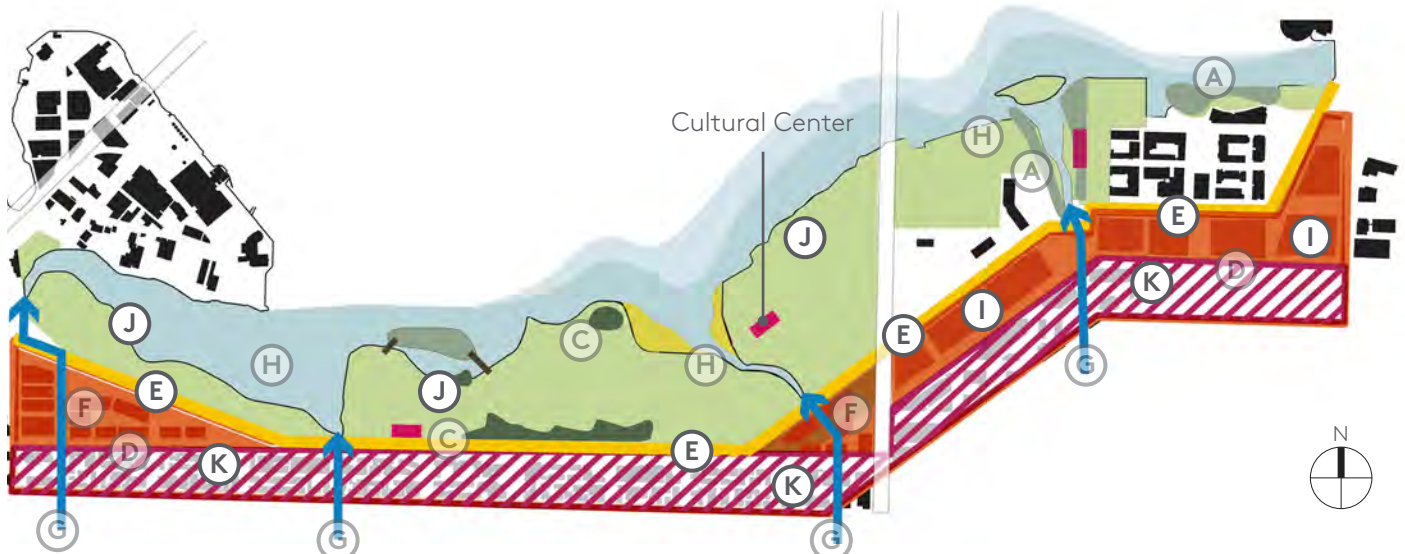
- E** Blue-Green Corridor - becomes the new future flood control ribbon connected along 1st Ave & Lameys Mill Rd
- F** Upland Development Areas Constructed to be adaptable and floodable for future sea level rise scenarios
- G** District scale Blue-Green Systems connected to restored waterfront
- H** Ecosystem Restoration
- I** Future Upland Development Areas - planning for increased density

1.0m Sea Level Rise - 500yr; 0.2% AEP Event Overlay

At 1m of SLR, the Habitat Bench and Forest Berm will continue to provide protection in Stamps Landing and Olympic Village. Assets in high risk areas have been phased out and the Blue-Green Corridor protects areas south of 1st Ave.



4. Retreat to 1st & 6th Ave

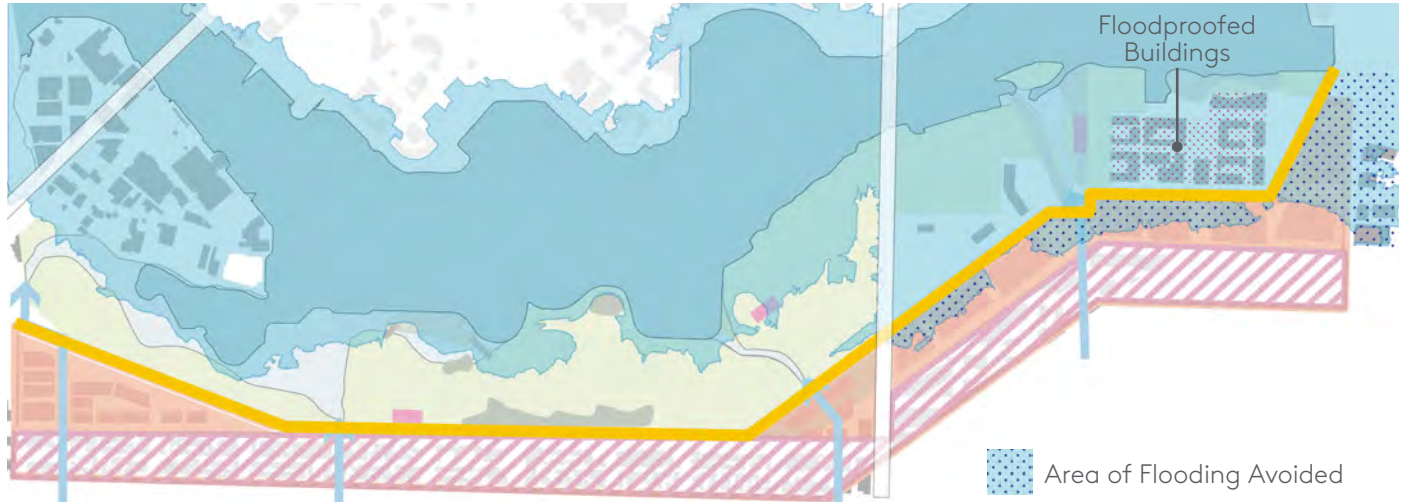


Over time, buildings will reach end of life and be phased out. Rather than rebuilding in these floodable areas, the landscape is restored, focusing on ecosystems, community amenities and open space, and cultural connections with Musqueam, Squamish and Tsleil-Waututh Nations. Everything North of the Blue-Green Corridor is floodable. Planning and development continues along Host Corridor, working toward a more connected and holistic approach to a floodable district.

- E** Blue-Green Corridor - becomes the new future flood control ribbon and density shifts south of the ribbon
- I** Upland Development Areas Constructed to be adaptable and floodable for future sea level rise scenarios
- J** Ecosystem Restoration
- K** Future Upland Development Areas - planning for increased density

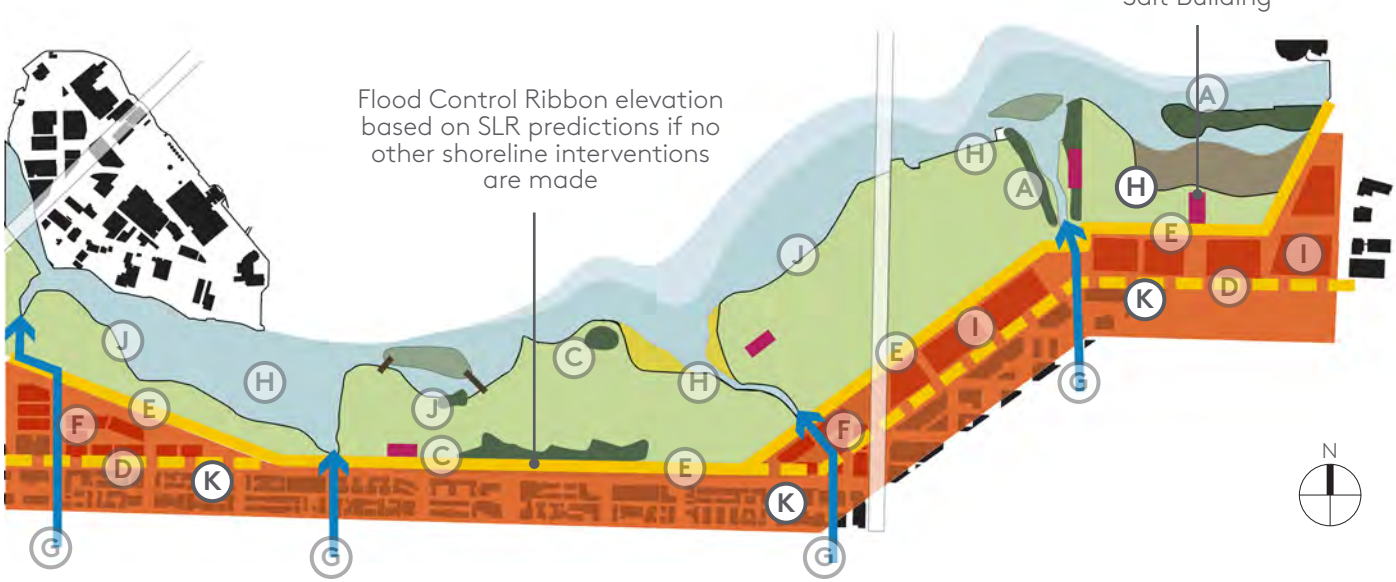
1.5m Sea Level Rise - 500yr; 0.2% AEP Event Overlay

With SLR increasing to 1.5m, most areas of development have been phased out, with density shifting south of 1st Ave or elsewhere in the city. Olympic Village is highly vulnerable to storm events and buildings need to be floodproofed to remain functional after storms.





5. Living with Water



The remaining structures and infrastructure north of the flood control line are eventually removed in phases, making space for ecosystem processes that were historically present. The Blue-Green Corridor/Flood Control Ribbon is raised incrementally to respond to SLR projections. The natural areas to the north serve as a living levee, allowing space for habitat migration over time. Watershed investments and basin wide issues have been addressed, allowing tidal and shoreline ecosystems to thrive. Investments shift to 2nd and 6th Ave. Host Corridor is built out with the density to support a growing Vancouver in addition to the density being shifted from the shoreline. A new shoreline community is established.

- (K) Upland Development Areas Constructed to be adaptable and floodable for future sea level rise scenarios
- (H) Ecosystem Restoration

2.0m Sea Level Rise - High Tide & 500yr; 0.2% AEP Event Overlay

At 2m of SLR, all areas within the historic area of fill have been retreated from. Community buildings that remain are resilient and adaptable. The 1st Ave Blue-Green Corridor protects areas to the south, while



First Step Costing Brief—



Planning for Pilot Projects

After the completion of the recommended future studies, a holistic vision for False Creek may be developed to further define the ideas and concepts set forth in this visioning process, applying strategies to specific sites and along the waterfront. A parallel planning effort for pilot projects can inform and be informed by the vision but can be done in a more immediate timeframe.

In order to determine what pilot projects should be and in what order they should be implemented, it is necessary to establish the baseline conditions for the waterfront. An assessment of vulnerability and risk of shoreline assets, coupled with identification

of partnerships and funding is critical to complete in the near term as a tool to determine priority and opportunity locations for pilot projects. This assessment will provide the primary information needed to prioritize future pilot projects along the waterfront.

In addition to shoreline conditions, pilot projects should be selected based on a number of criteria using a multiple objective decision analysis. An analysis of these criteria will provide a point of comparison for future projects. The prioritization of projects should weigh the multiple benefits that can be achieved and the timeframe in which it is necessary to act. The criteria for prioritizing potential pilot projects are:



- Is the current shoreline vulnerable to future storm events?
- Is the property city owned, private, or a combination?
- Is there deferred maintenance that will require reinvestment?
- Can the project achieve on-site mitigation?
- Can the project serve as a precedent for other locations along the waterfront?
- Does the project have the opportunity to focus on multiple benefits addressing community values and public engagement and education?
- Can the project be co-design and co-managed with Musqueam, Squamish and Tsleil-Waututh Nations?

To create a connected holistic experience for the entire waterfront, pilot projects must be developed with principles, functions, uses, programs and design language that follows the intent of the vision and allows for a continuous experience.

Continued visioning efforts should inform pilot projects, and as pilot projects come on-line, the process and lessons learned from those projects should also inform the vision. The following outlines the Forest Berm and Habitat Bench Pilot projects. Although not included in this section, it is recommended that a Blue-Green Corridor pilot project be explored along 1st Ave.





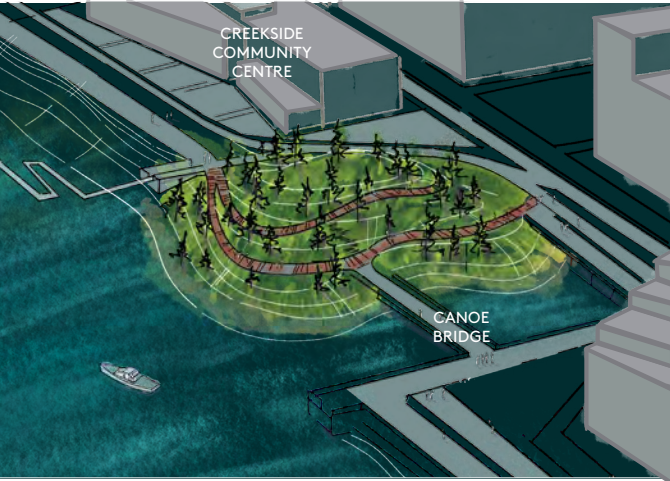
Forest Berm Pilot Project

An initial phase of the Forest Berm could be installed west of the Creekside Community Recreation Centre. Replacing much of the largely impervious plaza and a portion of the hardened seawall, this natural landscape typology could be a new and unique experience for people in Olympic Village.

This pilot project can be scaled up or down based on the implementation time horizon, level of investment, or certainty around environmental remediation requirements. Based on the initial investigations into the feasibility, this project may be scaled down to a demonstration garden, showing how a successional landscape can be established in an urban environment, or it may be scaled up to remediate contaminated soils, excavate below the existing surface, and establish a landscape that is meant to last many generations.

Because of it's location in Olympic Village near the Community Centre, there are many opportunities for eduction and interpretation .

Forest Berm Pilot Project



Life cycle and Phasing Considerations

The Forest Berm Cost Table summarizes the initial installation costs and associated short term maintenance costs for the Forest Berm. Beyond standard soft costs associated with planning, permitting, and financing, funds should be available to support community-based and Musqueam, Squamish and Tsleil-Waututh partnerships through design and co-management.

The long-term success and ability for the forest berm ecosystem to thrive over time relies on adaptive co-management strategies defined and executed over the decades following installation. Although it is challenging to predict the long term costs associated with long-term management and to predict the ways in which the forest berm may need to be adapted, phasing considerations include:

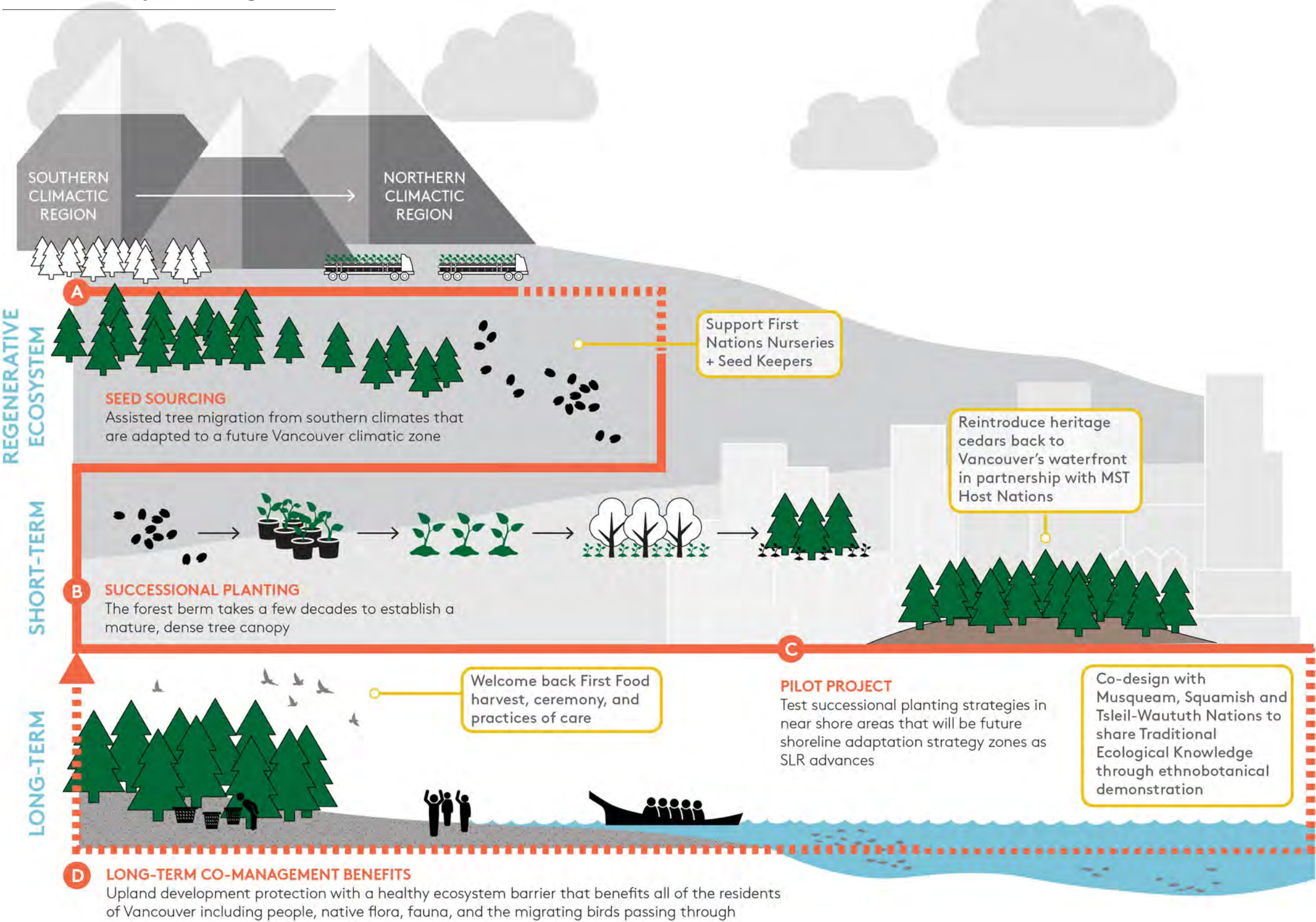
- Phase 1 - Initial installation costs. Planting of a fast growing native deciduous forest of Alder and Willow species.
- Phase 2 - Maintenance, clearing and Planting of native conifer seedlings within the established planting areas.
- Phase 3 - Long-term stewardship and planting of a diverse native understory.
- Phase 4 - As the shoreline and landscape around the forest berm transforms in the long-term, the canoe bridge, boardwalk, and other human-centered infrastructure may be removed as the forest ecosystem is established.

Forest Berm Cost Table

Client: City of Vancouver						Date: 9-Nov-22			
Project: Sea2City Design Challenge						Prepared By: LW			
						Reviewed By: YN			
OPINION OF PROBABLE COST									
Description		Unit	Quantity	Unit Price	Item Cost	Contingency		TOTAL	
						%	Amount		
1	Forest Berm								
1.1	General demolition, top soil stripping, stockpile on site and subgrade preparation		sq.m.	4,100	\$15.00	\$61,500	50%	\$30,750	\$92,250
1.2	Rock revetment		tonnes	1,000	\$89.00	\$89,000	50%	\$44,500	\$133,500
1.3	Fill		tonnes	10,000	\$114.00	\$1,140,000	50%	\$570,000	\$1,710,000
1.4	Phase 1 Plant Supply and Installation								
	Topsoil		cu.m.	1,060	\$90.00	\$95,400	50%	\$47,700	\$143,100
	Planting		sq.m.	3,500	\$90.00	\$315,000	50%	\$157,500	\$472,500
	Trees		ea	40	\$200.00	\$8,000	50%	\$4,000	\$12,000
	Mulch		sq.m.	3,500	\$6.00	\$21,000	50%	\$10,500	\$31,500
	Temporary Irrigation		sq.m.	3,500	\$40.00	\$140,000	50%	\$70,000	\$210,000
1.5	Phase 2 Plant Supply and Installation								
	Planting		sq.m.	1,200	\$90.00	\$108,000	50%	\$54,000	\$162,000
	Trees		ea	40	\$200.00	\$8,000	50%	\$4,000	\$12,000
	Mulch		sq.m.	3,500	\$6.00	\$21,000	50%	\$10,500	\$31,500
2	Landscape Features								
2.1	Asphalt paving (50mm thick, 2m wide)		sq.m.	500	\$180.00	\$90,000	50%	\$45,000	\$135,000
2.2	Fencing		m	150	\$115.00	\$17,250	50%	\$8,625	\$25,875
2.3	Boardwalk		sq.m.	110	\$360.00	\$39,600	50%	\$19,800	\$59,400
2.4	Boardwalk Structure		ea	12	\$34,000.00	\$408,000	50%	\$204,000	\$612,000
2.5	Habitat Snags		ea	4	\$25,000.00	\$100,000	50%	\$50,000	\$150,000
2.6	Interpretative Signage (metal base, concrete footing) - excluding content research and graphic layout		ea	5	\$2,000.00	\$10,000	50%	\$5,000	\$15,000
3	General								
3.1	General Contractor Mobilization/Demobilization/Insurance (approx 10% of Total Construction Cost)		L.S.	1	\$200,000.00	\$200,000	50%	\$100,000	\$300,000
3.2	Environmental Protection Measures		Allowance	1	\$50,000.00	\$50,000	50%	\$25,000	\$75,000
3.3	Pre- and Post-Construction Survey		L.S.	1	\$10,000.00	\$10,000	50%	\$5,000	\$15,000
3.4	Site Closeout		L.S.	1	\$15,000.00	\$15,000	50%	\$7,500	\$22,500
4	Monitoring								
4.1	Construction Monitoring (approx. 5% of Total Construction Cost)		L.S.	1	\$100,000.00	\$100,000	50%	\$50,000	\$150,000
4.2	Post-construction marsh and riparian plant monitoring (year 1,2,3 and 5)		year	4	\$10,000.00	\$40,000	50%	\$20,000	\$60,000
		Total				\$3,086,750		\$1,543,375	\$4,630,125
Disclaimer:									
These cost estimates are an opinion of construction cost made by the consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the costs of labour, equipment, or materials, or over contractors' methods of determining prices or bidding. This opinion of construction cost is based on the consultant's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that contractors' bids will not vary from the opinion of cost prepared by the consultant.									
Notes:									
1. Costs reflect 2022 prices (in Canadian Dollars) at the 2% design level (Concept Screening - Class 5 estimate)									
2. Provincial Sales Tax (PST) will be applicable on permanent materials and has not been incorporated herein.									
3. Costs include delivery and installation, unless otherwise noted.									
4. Unit costs are based on a recent habitat offsetting project in BC with similar elements.									
5. Maintenance of plants (weeding and watering of plants) is not included.									



Forest Berm System Diagram:



The Forest Berm is both a pilot project as well as a first step investment in working toward the long-term vision for Olympic Village. Flood risk at Olympic Village is primarily caused by a few isolated points of entry along the shoreline. The long-term strategy for mitigating flood risk is to install the Forest Berm landscape type in those areas to cut off those points of sea level rise entry.

By investing early in these Forest Berms, the vegetation and habitats are able to grow and naturally change over time, offering multiple benefits beyond flood protection.

The pilot project is an intervention that demonstrates the short and long-term vision of climate adaption at Olympic Village. The Forest Berm provides the anchor for achieving the elevations needed to recreate a tidal mudflat, while establishing an upland forest typology. It is critical that this work begin in the near-term. This is a long-term generational investment that relies on understanding how this type of ecosystem can thrive in an urban environment with additional pressures of contaminated soils, salt water intrusion, disconnected groundwater systems, and the extreme precipitation and temperature swings associated with a changing climate.

The Forest Berm can serve as a research plot for a variety of studies and will require adaptive management and iterative experimentation to find the right balance between human intervention and natural ecosystem function. Central to this idea is the co-management of this space with Musqueam, Squamish, and Tsleil-Waututh Nations. This landscape will be developed as a successional forest, with a primary objective being to integrate more Western Red Cedar trees along the shoreline of False Creek. This project will further the understanding of how this species, with such significant cultural value to the Musqueam, Squamish and Tsleil-Waututh Peoples, can be a part of the long term vision for a healthy False Creek.



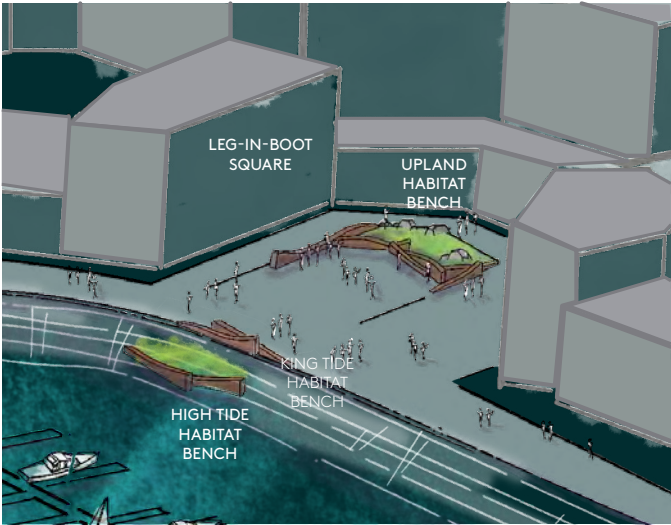
Habitat Bench Pilot Project

An initial phase of the Habitat Bench could be installed in three different locations at Leg-in-Boot Square in Stamps Landing. The three recommended installations will be located in a tidally influenced portion of the existing seawall, at the top of the seawall, and in an upland location.

These three installations provide an opportunity to monitor how and at what rate these elements age and to understand how community responds to and engages with these elements.

Through the monitoring and maintenance of these elements over the near-term, a determination can be made about whether this strategy is effective and scalable across False Creek. As other opportunities arise, the initial pilot project may be deconstructed and relocated to demonstrate the adaptive capacity as well as it’s future function as habitat structure.

Habitat Bench Pilot Project



Life cycle and Phasing Considerations

The Habitat Bench Cost Table summarizes the initial installation costs and associated short term maintenance costs for the Habitat Bench. Beyond standard soft costs associated with planning, permitting, and financing, funds should be available to support community-based and Musqueam, Squamish and Tsleil-Waututh partnerships through design and co-management. The design, construction, integration of art and development of the interpretation can be lead by Musqueam, Squamish and Tsleil-Waututh.

Because the Habitat Bench is intended as having multiple end-of-life reuse possibilities, the up front costs are a small part of the long-term story.

Soft costs associated with the initial investment may include:

- Engaging Musqueam, Squamish and Tsleil-Waututh forest managers, and urban arborists to source the timber materials
- Commissioning Musqueam, Squamish and Tsleil-Waututh Nation members and artists to explore opportunities for carving, murals and story telling
- Monitoring the performance, structure and longevity of the timber elements

Long-term costs may include

- Replacement of timber elements as they decompose
- Relocation of timber elements as habitat structures within the new and established ecosystems

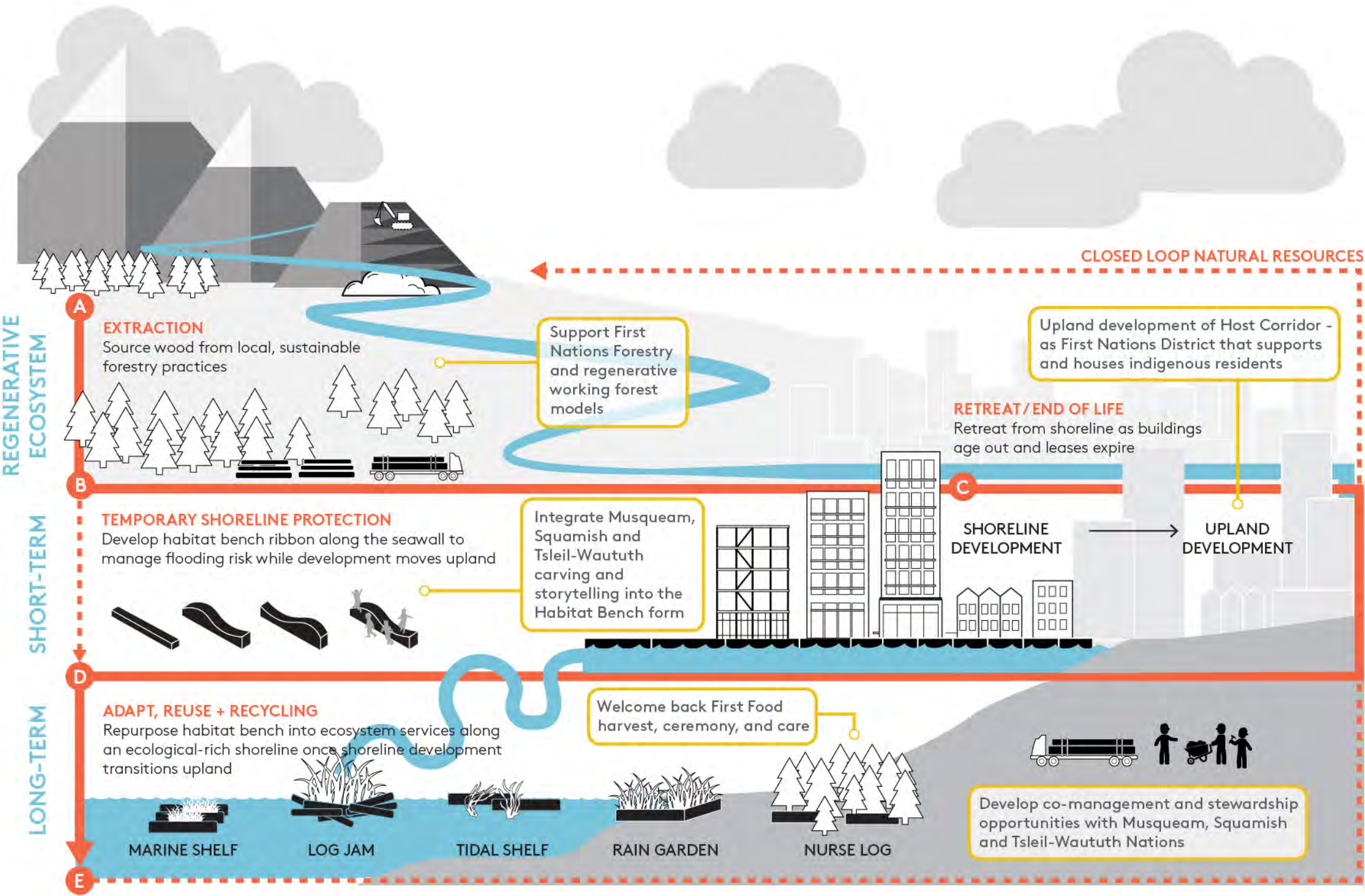
Habitat Bench Cost Table

Client: City of Vancouver					Date: 9-Nov-22			
Project: Sea2City Design Challenge					Prepared By: LW			
					Reviewed By: YN			
OPINION OF PROBABLE COST								
Description		Unit	Quantity	Unit Price	Item Cost	Contingency		TOTAL
						%	Amount	
1	High Tide Habitat Bench (Marine Shelf)							
1.1	Timber Pieces	ea	4	\$6,000.00	\$24,000	50%	\$12,000	\$36,000
1.2	Concrete anchors	L.S.	1	\$25,000.00	\$25,000	50%	\$12,500	\$37,500
1.3	Plant Supply and Installation							
	Topsoil	cu.m.	1,060	\$90.00	\$95,400	50%	\$47,700	\$143,100
	Planting	sq.m.	100	\$90.00	\$9,000	50%	\$4,500	\$13,500
	Mulch	sq.m.	100	\$6.00	\$600	50%	\$300	\$900
	Temporary Irrigation	sq.m.	100	\$40.00	\$4,000	50%	\$2,000	\$6,000
1.4	Growing Medium	tonnes	100	\$114.00	\$11,400	50%	\$5,700	\$17,100
2	King Tide Habitat Bench (Tidal Shelf / Rain Garden)							
2.1	Timber Pieces	ea	8	\$6,000.00	\$48,000	50%	\$24,000	\$72,000
2.2	Concrete anchors	L.S.	1	\$25,000.00	\$25,000	50%	\$12,500	\$37,500
2.3	Earthwork (grading)	L.S.	1	\$10,000.00	\$10,000	50%	\$5,000	\$15,000
2.4	Interpretative Signage (metal base, concrete footing) - excluding content research and graphic layout	ea	1	\$2,000.00	\$2,000	50%	\$1,000	\$3,000
3	Upland Habitat Bench (Log Jam / Nurse Log)							
3.1	Timber Pieces	ea	12	\$6,000.00	\$72,000	50%	\$36,000	\$108,000
3.2	Concrete anchors	L.S.	1	\$50,000.00	\$50,000	50%	\$25,000	\$75,000
3.3	Plant supply and Installation							
	Topsoil	cu.m.	200	\$90.00	\$18,000	50%	\$9,000	\$27,000
	Planting	sq.m.	400	\$90.00	\$36,000	50%	\$18,000	\$54,000
	Mulch	sq.m.	400	\$6.00	\$2,400	50%	\$1,200	\$3,600
	Temporary Irrigation	sq.m.	400	\$40.00	\$16,000	50%	\$8,000	\$24,000
3.4	Growing medium	tonnes	300	\$114.00	\$34,200	50%	\$17,100	\$51,300
3.5	Earthwork (grading)	L.S.	1	\$10,000.00	\$10,000	50%	\$5,000	\$15,000
5	General							
5.1	General Contractor Mobilization/Demobilization/Insurance (approx 10% of Total Construction Cost)	L.S.	1	\$100,000.00	\$100,000	50%	\$50,000	\$150,000
5.2	General demolition, top soil stripping, stockpile on site and subgrade preparation	sq.m	1,000	\$15.00	\$15,000	50%	\$7,500	\$22,500
5.3	Environmental Protection Measures	Allowance	1	\$50,000.00	\$50,000	50%	\$25,000	\$75,000
5.4	Pre- and Post-Construction Survey	L.S.	1	\$10,000.00	\$10,000	50%	\$5,000	\$15,000
5.5	Site Closeout	L.S.	1	\$15,000.00	\$15,000	50%	\$7,500	\$22,500
6	Monitoring							
6.1	Construction Monitoring (approx. 5% of Total Construction Cost)	L.S.	1	\$50,000.00	\$50,000	50%	\$25,000	\$75,000
6.2	Post-construction marsh and riparian plant monitoring (year 1,2,3 and 5)	year	4	\$5,000.00	\$20,000	50%	\$10,000	\$30,000
Total					\$833,000		\$416,500	\$1,129,500
Disclaimer:								
These cost estimates are an opinion of construction cost made by the consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the costs of labour, equipment, or materials, or over contractors' methods of determining prices or bidding. This opinion of construction cost is based on the consultant's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that contractors' bids will not vary from the opinion of cost prepared by the consultant.								
Notes:								
1. Costs reflect 2022 prices (in Canadian Dollars) at the 2% design level (Concept Screening - Class 5 estimate)								
2. Provincial Sales Tax (PST) will be applicable on permanent materials and has not been incorporated herein.								
3. Costs include delivery and installation, unless otherwise noted.								
4. Unit costs are based on a recent habitat offsetting project in BC with similar elements.								
5. Maintenance of plants (weeding and watering of plants) is not included.								



Habitat Bench System Diagram:

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The Habitat Bench Pilot Project demonstrates how a simple, near-term shoreline intervention can provide temporary protection for occasional flood events and support future habitat functions through adaptive reuse.

The Habitat Bench is made of locally sourced timber and is designed as a modular element that is temporary, deconstructable, and designed for decomposition and adaptive relocation. As sections of the Habitat Bench start to deteriorate and need to be replaced, or as upland investments in shoreline restoration occur making protection no longer necessary, these sections can be deconstructed and relocated within restored areas of the landscape. In it's second life, the Habitat Bench acts as a network of nurse logs and habitat structures in a variety of settings.

Inspired by the story of the Double-headed Serpent, shared with the design team by the team's cultural advisors, the base design of the Habitat Bench takes on an undulating form. The Habitat Bench is imagined as a canvas for storytelling and interaction which could be expressed as a bench, a play element, an art installation, wood carving and murals to tell the story of how the shoreline will change over time.

The pilot project does not address a few conditions that would enable this to be a continuous functioning flood control measure. Future design explorations and studies might include the following considerations:

- How does this modular element tie into adjacent structures or other segments of the habitat bench to provide a continuous structure?
- What elements help create a water-tight barrier within these structures?
- How does the Habitat Bench interact with the top of the seawall where curbs, no curbs, or other structures are present?

